INSTRUCTION MANUAL

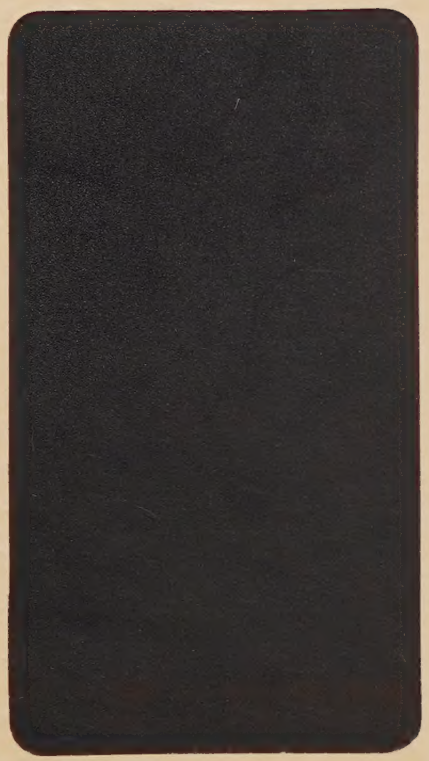
# Type 1568-A
# Wave Analyzer

## 1% BANDWIDTH

C

GENERAL RADIO

MP MASTER
MA33839



## WARRANTY

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, District Office, or authorized repair agency personnel will be repaired or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

# Type 1568-A Wave Analyzer

## 1% BANDWIDTH

C

Copyright 1967 by
GENERAL RADIO COMPANY
West Concord, Massachusetts U.S.A. 01781
Form 1568-0100-C
Sept, 1968
ID-1498

## CONDENSED OPERATING INSTRUCTIONS

1. Set the FUNCTION switch to CK BAT. If the meter indicator falls within the region marked BAT, proceed. If not, refer to paragraph 3.1.1 in this manual.

2. Set the FREQUENCY dial and MULTIPLIER switch to indicate the frequency of the component to be measured (the reading of the FREQUENCY dial is to be multiplied by the MULTIPLIER indication of the same color).

3. If a calibrated meter reading in volts is required, set the FUNCTION switch to CAL and adjust the MAX INPUT VOLTS switch and the METER RANGE switch so that the white dots on both dials are straight up (at 12 o'clock). Adjust the CAL control so that the meter indicator falls in the area marked CAL.

4. Set the MAX INPUT VOLTS switch (black knurled dial) so that the white arrow points to a voltage just higher than the rms level of the input signal.

5. Set the METER RANGE switch (gray knob and clear plastic dial) so that the white area lies under the expected level of the input-signal component to be measured.

6. Set the FUNCTION switch to FAST, unless the signal to be analyzed contains a large amount of noise. In the latter case, set the FUNCTION switch to SLOW.

7. Apply the signal to be analyzed to the INPUT terminal of the Type 1568 via a telephone plug. The analyzer meter will indicate the level of the component for which the FREQUENCY controls are set. Fine tune the FREQUENCY as necessary.

8. If analyzer is connected to a source of ac power, and automatic frequency-range changing (MULTIPLIER switch steps clockwise each time FREQUENCY dial sweeps through blank region) is desired, set the MULTIPLIER SWITCHING slide switch to AUTO; otherwise set this switch to MANUAL.

9. Obtain the filtered component of the input signal from the analyzer OUTPUT jack via a telephone plug, if monitoring or recording of this signal is required.

10. If more detailed instructions on the operation of the analyzer are required, refer to Section 3 of this book. In particular, refer to paragraph 3.8 for instructions on the operation of the analyzer with the Type 1521 Graphic Level Recorder.

# TABLE OF CONTENTS


Section 1 INTRODUCTION

1.1 Purpose ____ 1
1.2 Description ____ 1
1.3 Controls and Connectors ____ 3
1.4 Accessories Supplied ____ 3
1.5 Accessories Available ____ 5

Section 2 INSTALLATION

2.1 The Flip-Tilt Case ____ 6
2.2 Dimensions ____ 6
2.3 Mounting the Type 1568 ____ 6
2.4 Power Connection ____ 7
2.5 Mounting the Type 1568 with the Type 1521 ____ 7

Section 3 OPERATING PROCEDURE

3.1 Power ____ 9
3.2 Calibration ____ 9
3.3 Connection to Input ____ 10
3.4 Dynamic Range and Internal Noise ____ 10
3.5 Distortion Measurements ____ 10
3.6 Analysis of Signals Having Many Strong Components 11
3.7 Analysis of Random Signals ____ 12
3.8 Using the Type 1568 with the Type 1521 ____ 12

Section 4 APPLICATIONS

4.1 General ____ 17
4.2 Analysis of Simple Periodic Signals ____ 17
4.3 Analysis of Modulated Signals ____ 17
4.4 Analysis of Discrete Components at Low Frequencies ____ 18
4.5 Analysis of Noise Spectra ____ 18
4.6 Analysis of Sounds Produced by Machinery ____ 18
4.7 Mil-Standard-740B (SHIPS) ____ 18
4.8 Frequency Measurement of a Component ____ 18

Section 5 PRINCIPLES OF OPERATION

5.1 General ____ 19
5.2 Input ____ 19
5.3 Filter ____ 20
5.4 Output ____ 21
5.5 Calibrator ____ 21
5.6 Power Supply ____ 21

Section 6 SERVICE AND MAINTENANCE

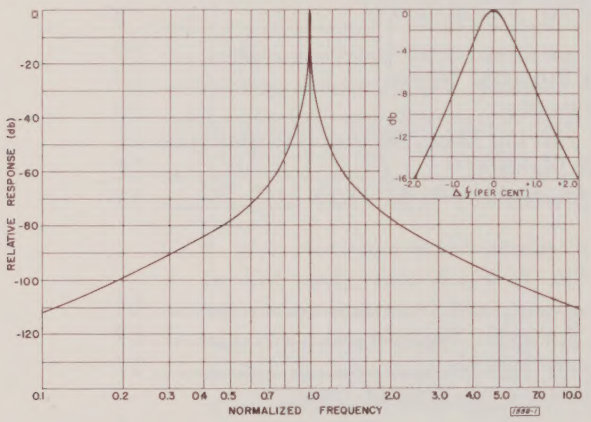
6.1 Warranty ____ 23
6.2 Service ____ 23
6.3 Access to Components ____ 23
6.4 Minimum Performance Specifications ____ 23
6.5 Calibration Procedure ____ 27
6.6 Trouble Analysis ____ 30

PARTS LIST and SCHEMATICS ____ 32

## SPECIFICATIONS

### FREQUENCY

**Range:** 20 Hz to 20 kHz in six half-decade bands.
**Dial Calibration:** Logarithmic.
**Accuracy of Frequency Calibration:** 1%.
**Filter Characteristics:** Bandwidth between 3-dB points on selectivity curve (see plot) is one percent of selected frequency.




Attenuation at 20% above and at 20% below selected frequency is greater than 50 dB referred to the level at the selected frequency. Attenuation at twice and at one-half the selected frequency is at least 75 dB referred to the level at the selected frequency. Ultimate attenuation is greater than 85 dB.

Uniformity of filter peak response with tuning is ±1 dB from 20 Hz to 6.3 kHz and ±2 dB from 20 Hz to 20 kHz.

### INPUT

**Impedance:** 100 kΩ.
**Voltage Range:** 100 μV to 300 V full scale in 3-10 series steps. Power is supplied at input socket for the Type 1560-P40 Preamplifier, which extends the sensitivity to 10 μV full scale and increases the input impedance to more than 500 MΩ.
**Distortion:** Input-circuit distortion is lower than -80 dB relative to input-signal level.

### OUTPUT

**Impedance:** 6000 Ω. Any load can be connected.
**Voltage:** At least one volt open circuit when meter reads full scale.
**Crest Factor Capacity:** Greater than 13 dB.

### GENERAL

**Analyzing Range:** 80 dB. Components of an input signal that differ in amplitude by as much as 80 dB can be measured.
**Automatic Recording:** Automatic range switching is provided to allow convenient, continuous spectrum plotting when the Type 1521 Graphic Level Recorder is used. Medium-speed motor is recommended.
**Amplitude Calibrator:** A built-in feedback-type calibration system permits amplitude calibration at any frequency within the analyzer's range.
**Power Supply:** 100 to 125 or 200 to 250 V, 50 to 60 Hz, 2 W. A rechargeable nickel-cadmium battery is also supplied. Battery provides about 20 h of operation when fully charged and requires 14 h for charging.
**Accessories Supplied:** Type CAP-22 Power Cord; Type 1568-2090 Detented Knob and Dial Assembly, used to facilitate measuring the components of an input signal as a percentage or in decibels with an arbitrary voltage reference.
**Cabinet:** Flip-Tilt. When cabinet is closed, dimensions are 13 ¼ by 13 by 18 ¼ inches (340, 330, 210 mm) over-all, including cabinet handle.
**Net Weight:** 21 ½ lb (10.0 kg).

*SECTION* 1

# INTRODUCTION

## 1.1 PURPOSE.

The Type 1568 Wave Analyzer fills the need for an inexpensive, portable wave analyzer having high harmonic rejection. Unlike many narrow-band spectrum analyzers, the Type 1568 features a bandwidth proportional to the frequency to which it is tuned. The analyzer is thus especially suited to applications in which the spectrum to be analyzed contains closely spaced discrete components or steep noise slopes at low audio frequencies. Such characteristics are common to the vibration spectra produced by various types of machines.

The combination of the Type 1568 with a Type 1521 Graphic Level Recorder forms an automatic spectrum plotter.

## 1.2 DESCRIPTION.

The Type 1568 is a general-purpose wave analyzer having a constant percentage bandwidth, measured between 3-dB points on the selectivity curve, of 1%. The Type 1568 has a high attenuation rate — a unique feature among constant-percentage-band analyzers — which results in more than 75 dB attenuation an octave away from the selected frequency.

The analyzer consists of three basic sections: input amplifier, filter, and output amplifier. The input amplifier section includes two calibrated step attenuators, one of which is adjusted by the MAX INPUT VOLTS switch. The other forms part of the analyzing attenuator and is adjusted by the METER RANGE switch. This section also includes a continuously adjustable attenuator, the CAL control, which is used to set precisely the over-all gain of the instrument.

The filter section consists of a synchronous cascade of two resonant (second order) filters. The filter is continuously tunable from 20 Hz to 20 kHz in six ranges. Additional sections of the analyzing attenuator are included in the filter section. The output amplifier raises the signal level high enough to operate the meter circuit and supplies an output signal for use with a recorder, headphones, or other devices.

Power for the analyzer is supplied by a 115- or 230-volt line or by an internal, rechargeable nickle-cadimum battery.

The Type 1568 is available in a portable version (catalog number 1568-9701) and in a relay-rack adapted version (1568-9820).

## TABLE 1-1
### Controls, Connectors, and Indicators of the Type 1568

| *Ref. No.* | *Name* | *Type* | *Function* |
|---|---|---|---|
| 1 | FUNCTION Switch | 6-position rotary switch | Turns analyzer on and off, selects meter speed (FAST or SLOW), selects auxiliary modes (CAL, CK BAT, CHARGE). FAST and SLOW speeds are those specified by the ASA for sound level meters. CAL mode allows analyzer to be amplitude-self-calibrated at any given frequency. Battery condition is indicated by meter (9) when switch set to CK BAT. If meter indicates outside area marked BAT, connect the instrument to an ac power line and select CHARGE mode. Sixteen hours are required to charge battery from fully discharged condition. |
| 12 | Charge Indicator Lamp | 28-V lamp, Drake Mfg. Co. No. 121-28-204 | Glows when battery is being charged. |
| 6 | CAL Control | Continuous rotary control | Adjusts gain for calibration. Use before applying input signal to set meter indication in CAL region, with FUNCTION switch (1) set to CAL and white dots on METER RANGE (10) and MAX INPUT VOLTS (11) switches set up (at 12 o'clock). |
| 7 | INPUT Jack | 2-connector telephone jack, Switchcraft No. 2J-1503 | For connection of input. Input impedance is 100 kΩ. Outer terminal connected to chassis ground. |
| 8 | INPUT Socket | 3-receptacle microphone socket, Cannon XLR Series | For connection of input signal via Type 1560-P40 Preamplifier or any other source fitted with a Type XLR connector. Terminals 1 and 3 parallel with telephone jack (7); terminal 2 supplies power for preamplifier (15 V). Accepts Cannon XLR-series connector, ELCO EL-series connectors (Part No. 00-2216-003), and Amphenol microphone connectors (Part No. 91-853). |
| 9 | | Panel meter Scales: 0 - 3 V, 0 - 10 V, -15 - +2 DBM | Indicates amplitude of selected frequency components in accordance with setting of MAX INPUT VOLTS and METER RANGE controls (10 and 11). Also indicates battery voltage (FUNCTION set to CK BAT) and registers circuit oscillations produced by proper adjustment of CAL control when FUNCTION switch set to CAL. |
| 11 | MAX INPUT VOLTS Switch | 8-position rotary switch (black, knurled dial) | Sets degree of attenuation of input signal. Correct setting prevents distortion due to overload of input circuits. Maximum voltage that should be applied to input circuit is indicated by white arrowhead.<br><br>NOTE<br><br>This control must not be adjusted during analysis of a signal. |

TABLE 1-1 (cont)

| Ref. No. | Name | Type | Function |
|---|---|---|---|
| 10 | METER RANGE Switch | 7-position rotary switch (clear dial with grey knob) | Selects meter range, which is indicated over white area on MAX INPUT VOLTS dial. Black scale indicates full-scale voltage; red scale indicates power in decibels referred to 1 mV in 600 Ω (1.6 nW). Red scale can also be used to indicate dB with an arbitrary voltage reference. |
| 5 | FREQUENCY MULTIPLIER | 6-position rotary switch (continuous, i.e., no stops) | Selects frequency range of analyzer. Multiply FREQUENCY dial (13) reading by indicated number to obtain selected frequency. When MULTIPLIER SWITCH (4) is set to AUTO (used during ac-line operation only), this control is advanced one clockwise position by an internal motor each time the FREQUENCY dial is swept through its blank region. |
| 13 | FREQUENCY Dial | Continuous rotary control | Selects, in conjunction with FREQUENCY MULTIPLIER, center frequency of 1%-bandwidth filter. Read white scale when FREQUENCY MULTIPLIER points to a white dot; read red scale when it points to a red dot. May be driven automatically from Type 1521 Graphic Level Recorder when Type 1521-P15 Link Unit with 16-toothed sprocket is used. |
| 4 | MULTIPLIER SWITCHING | 2-position slide switch | Connects (AUTO) or disconnects (MANUAL) motor that drives FREQUENCY MULTIPLIER when analyzer is line operated. Motor is automatically disconnected when analyzer is battery operated. |
| 2 | OUTPUT Jack | 2-connector telephone jack, Switchcraft No. 2J-1503 | Supplies filtered signal at a level of at least 1 V open circuit corresponding to full-scale meter indication. Output impedance is 6 kΩ. |
| 3 | POWER Connector | 3-connector power plug | For application of 115-V or 230-V ac power to charge battery or to operate the instrument. Ac power must be supplied when automatic multiplier switching is to be used. Battery and analyzer circuits are in parallel, so analyzer will not operate properly from line if battery is fully discharged. Removal of the external power source does not turn off the instrument. |

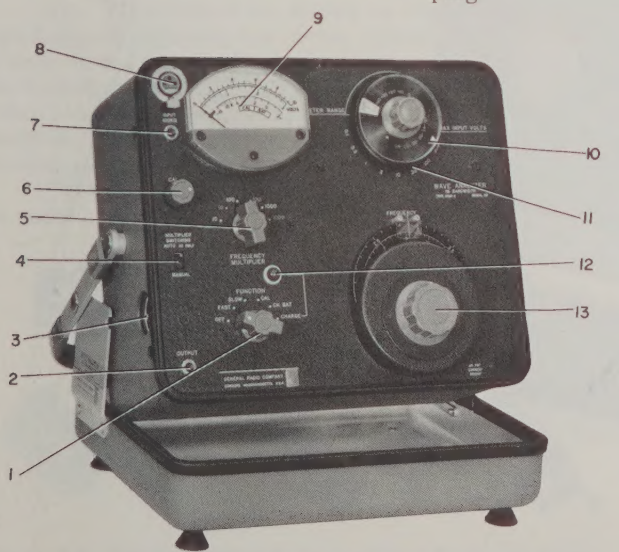



**Figure 1-1. Controls and connectors of the Type 1568 Wave Analyzer.**

## 1.3 CONTROLS AND CONNECTORS.

The controls, indicators, and connectors of the Type 1568 are indicated in Figure 1-1 and listed in Table 1-1.

## 1.4 ACCESSORIES SUPPLIED.

The accessories supplied with the Type 1568 Wave Analyzer are listed in Table 1-2 and shown in Figure 1-2.

## TABLE 1-2

### Accessories Supplied with the Type 1568 Wave Analyzer

| *Figure 1-2 Ref. No.* | *Item* | *Description* | *Part Number* |
|---|---|---|---|
| 1 | Type CAP-22 3-Wire Power Cord | 7-foot, 3-connector plug to 3-connector socket | 4200-9622 |
| 2 | Type 1560-P95 Cable Assembly | 3-foot shielded cable, phone plug to double plug. (Connects the Type 1568 with a Type 1521 Graphic Level Recorder or other device. | 1560-9695 |
| 3 | Handbook of Noise Measurement | | 5301-8100 |
| 4 | Nut | Replaces CAL knob to convert to a screwdriver control in case this feature is desired. | 5840-0200 |
| 5 | Type 1568-2090 Knob and Dial Assembly | Replaces METER RANGE knob for applications in which an arbitrary level reference is desired. Has two scales: 0.1% to 100% and 0 to -60 dB. The dial of this assembly can be turned with respect to the knob. | 1568-2090 |

**Figure 1-2. The Type 1568 Wave Analyzer. Below are shown the accessories included with the instrument.**

TABLE 1-3
Other Accessories Available for the Type 1568 and/or Type 1521

| *Item* | *Purpose* | *Part Number* |
|---|---|---|
| Type 1521-P15 Link Unit | For attachment to FREQUENCY control of the Type 1568 for chain drive with the Type 1521. | 1521-9615 |
| Type 1521-6082 16-Tooth Gear | Used with Link Unit to provide correct scale factor for Type 1568. | 1521-6082 |
| Type 1521-P10B Drive Unit | Provides coupling to Link Unit on the Type 1568. Combination of Link Unit, 16-Tooth Gear, and Drive Unit synchronizes Type 1568 FREQUENCY to special recording paper listed below. | 1521-9647 |
| Type 1521-9475 Chart Paper | Calibrated 2 Hz to 20 Hz (normalized), logarithmic, 10 inches per frequency decade. | 1521-9475 |
| Type 1521 Graphic Level Recorder | To record the output of the analyzer and automatically plot spectra. | 1521-9802 (60-Hz, bench)<br>1521-9812 (60-Hz, rack)<br>1521-9506 (50-Hz, bench)<br>1521-9507 (50-Hz, rack) |
| Type 1560-P52<br>Type 1560-P53<br>Type 1560-P54 } Vibration Pickup | Used, with the Type 1560-P40 Preamplifier, to measure acceleration spectra. | 1560-9652<br>1560-9653<br>1560-9654 |
| Type 0481-9756 Rack Adaptor Set | For rack-mounting the portable model of the Type 1568. | 0481-9756 |

## 1.5 ACCESSORIES AVAILABLE.

### 1.5.1 THE TYPE 1560-P40 PREAMPLIFIER.

The Type 1560-P40, shown in Figure 1-3, is a high-input-impedance, low-noise preamplifier particularly suited for amplifying the outputs of piezoelectric transducers and for driving long connecting cables without loss of signal voltage. A switch on the preamplifier selects a voltage gain of either 1:1 or 10:1. Complete specifications are given in the Appendix.

The preamplifier is housed in a small cylindrical case. The Type 1560-P5 Microphone cartridge plugs directly on to the input end of the case. Adaptors are available for connecting the preamplifier to the cartridge of the Type 1560-P3 Microphone, to GR874 Coaxial Connectors (Type 1560-P98), and to 3-terminal microphone connectors (Type 1560-P96). Output from the preamplifier is through a 3-terminal shielded connector. The required dc supply can be obtained directly from the Type 1568 Analyzer.

**Figure 1-3. The Type 1560-P40 Preamplifier. Below are shown accessories available for the preamplifier (left to right): The Type 1560-P5, the Type 1560-P96, and the Type 1560-P98.**

The preamplifier and accessories are available in various combinations (refer to the Appendix).

The Type 1560-P40H Preamplifier and Power Supply Set is self-powered and independent of any external supply.

The Type 1560-P40J* Preamplifier and Adaptor Set, dependent for its power on the instrument to which it is connected, can be used with the Type 1568 Analyzer.

The Type 1560-P40K Preamplifier and Microphone Set can be used with the Type 1568 Analyzer when an acoustical measurement is needed at low levels and the microphone must be mounted at the end of a long cable.

### 1.5.2 OTHER AVAILABLE ACCESSORIES.

Table 1-3 lists other accessories available for the Type 1568 Wave Analyzer.

**General Radio Experimenter*, Vol 39, No. 6, June 1965.

*SECTION* 2

# INSTALLATION

## 2.1 THE FLIP-TILT CASE.

Directions for opening the Type 1568 Wave Analyzer are given on the handle of the Flip-Tilt case. Once open, the instrument can be tilted to any convenient angle, as shown in Figure 1-1. The instrument should be placed to give the most convenient access to the knobs and the best view of both the panel control settings and the meter indication.

The case can be locked fully open by means of the same slide pins that are used to lock it when it is closed. It can be carried in the open position, with the cover firmly in place.

## 2.2 DIMENSIONS.

The dimensions of the Type 1568 are illustrated in Figure 2-1 (portable model) and Figure 2-2 (rack model).

## 2.3 MOUNTING THE TYPE 1568.

The Type 1568 Wave Analyzer is supplied in two models: portable and rack-converted. The portable model may be converted to the rack model by means of an adaptor set, catalog number 0481-9756. To rack mount the Type 1568 Wave Analyzer using this adaptor set, proceed as follows (see Figure 2-3):

a. Remove and retain the four 10-32 screws (A) holding the instrument to the case. Lift the instrument out of the case.

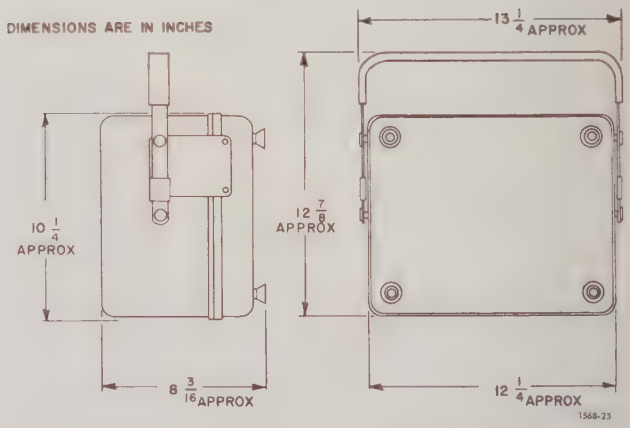



Figure 2-1. Dimensions of the Type 1568 portable model.

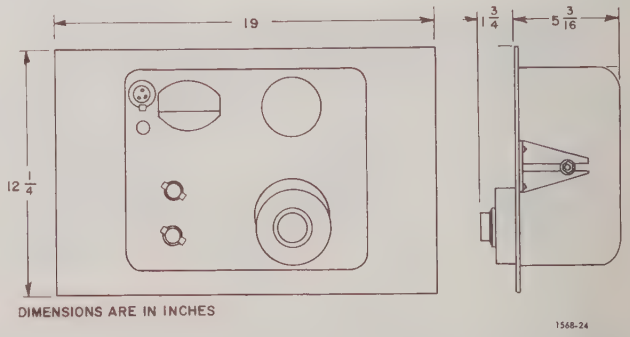



Figure 2-2. Dimensións of the Type 1568 rack-converted model.

b. Remove the two 1/4-28, 3/8-in screws from the pivot stud (B) which holds the cabinet to the handle and cover assembly. Remove the cabinet and replace those screws with the two 1/4-28, 3/4-in screws (C) included in the adaptor set. Add a lockwasher and nut to each and tighten. Add a flat washer to each screw.

c. Attach brackets (D) and plates (E) to the rack adapter panel as shown. Tighten the nuts on the bracket studs securely, but leave the others only hand tight.

d. Place the empty cabinet in the panel and attach it to the brackets securely with the lock washers, flat washers, and nuts provided. Slide the plates over so they rest firmly against the sides of the cabinet and tighten them down.

e. Flip the panel and cabinet over and place the instrument in the cabinet. Replace the four screws (A) removed in step a.

f. The instrument can now be mounted in a standard 19-in relay rack with four 10-32, 1/2-in screws with black nylon cupwashers.

## 2.4 POWER CONNECTION.

The Type 1568 has an internal battery and can therefore be operated remote from any external power source. When an ac power source is available, however, the analyzer should be operated from it. The power consumption of the Type 1568 is 2 W for normal operation and 3.5 W for battery charging. A three-terminal source of either 100 to 125 V, 50 to 60 Hz, for which the instrument is normally supplied, or a source of 195 to 250 V, 50 to 60 Hz, can be connected to the Type 1568 via the power cord supplied. The third wire of this cord grounds the chassis of the instrument.

To convert a 100- to 125-V instrument for 195- to 250-V operation, remove the instrument from its case (per directions in paragraph 6.3), disconnect terminals 1 and 2 and terminals 3 and 4 on the power supply etched board (Figure 6-9), and connect terminal 2 to terminal 3. Then, solder a short wire across terminals AT508 and AT517 (also on the power-supply etched board). When this conversion is made, a new power-input plate should replace the old one (order from General Radio by part number 5590-0500 for 100- to 125-V, 5590-1669 for 195- to 250-V operation). For information concerning battery operation, charging, discharging, etc, refer to paragraph 3.1.

## 2.5 MOUNTING THE TYPE 1568 WITH THE TYPE 1521.

Figure 2-4 shows the portable Type 1568 Wave Analyzer in its Flip-Tilt case mounted above the Type 1521 Graphic Level Recorder. The relay-rack adapted analyzer (Type 1568-9820) can also be mounted with the recorder. To couple the two instruments, proceed as follows:

a. Remove the FREQUENCY control knob-and-plate assembly that is fastened to the dial cover with a screw on each side of the knob.

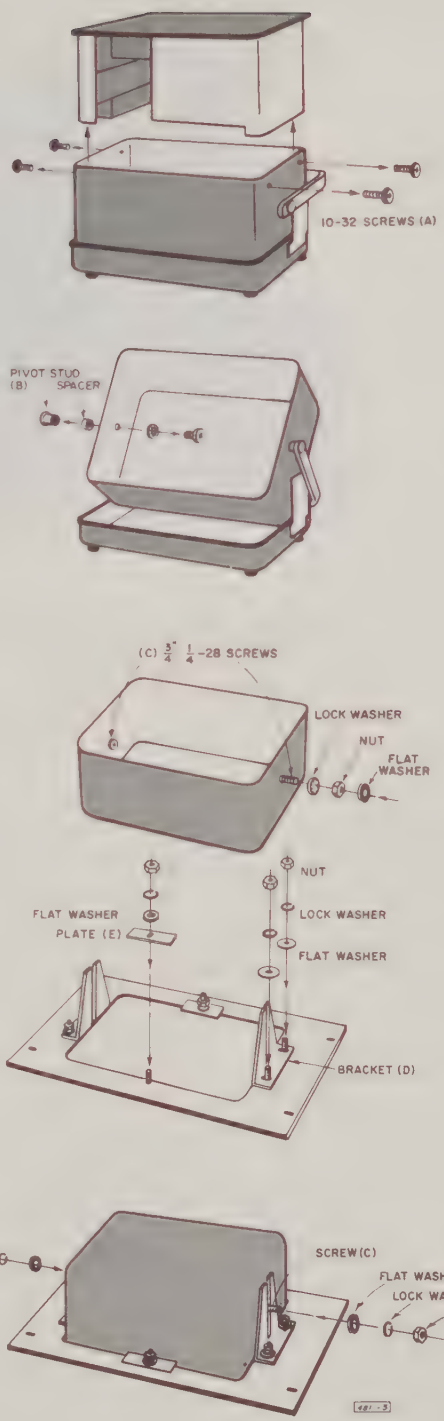



**Figure 2-3. Rack mounting the Type 1568 portable model.**

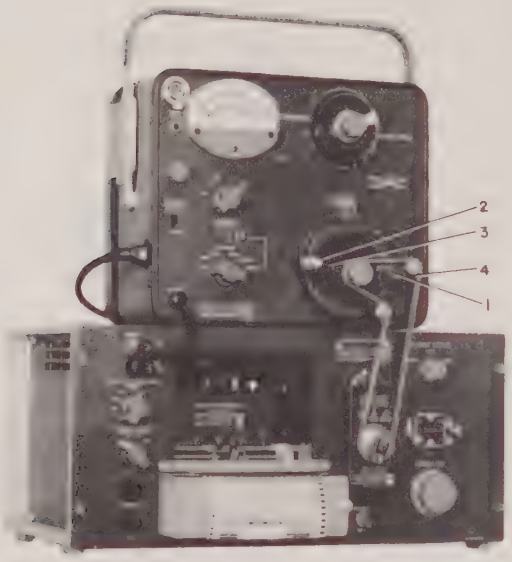



Figure 2-4. The Type 1568 with the Type 1521 Graphic Level Recorder.

b. Place the Type 1521-P15 Link Unit (1 in Figure 2-4) over the FREQUENCY dial cover, orienting the Link Unit as shown in Figure 2-4.

c. Loosen the locking screw (2) and rotate the black sprocket plate so that the access hole (3) is over one set of elongated holes in the gray-crackle Link-Unit plate. Place one of the screws removed in step a in the inner elongated hole and tighten to fasten the Link-Unit plate to the FREQUENCY dial cover.

d. Rotate the black sprocket plate to obtain access to the other set of elongated holes. Insert the other screw into the inner hole and tighten.

The Link Unit should be adjusted so that there is a slight amount of backlash when the knob in the Link Unit is turned. To make this adjustment, loosen the screws in the gray-crackle plate, slide the plate up or down as necessary, then retighten the screws.

e. Replace the 24-tooth gear (supplied) with the 16-tooth gear : with a 3/32-in Allen wrench, loosen the setscrews holding the gray knob to the Link Unit, remove the knob and the 22-tooth gear, place the 16-Tooth Gear on the shaft, and replace the knob.

f. Install the chain (4) as shown in the figure. Two chains are supplied with the Link Unit. Use the short chain with the analyzer in its Flip-Tilt case; the long chain must be used with the relay-rack model. To tighten the chain, loosen the locking screw (2), rotate the black sprocket plate to take up most of the slack, and retighten the screw.

NOTE

This assembly is available as a racked system (Type 1913 Recording Wave Analyzer, 1% Bandwidth) with a common power control and accessory drawer.

SECTION 3

# OPERATING PROCEDURE

## 3.1 POWER.

### 3.1.1 CHARGING THE BATTERY.

An internal nickel-cadimum battery, which floats across the output of the line-filtering circuit, supplies power to the Type 1568 when the ac line is disconnected, providing about 20 hours of operation. To see whether this battery needs charging, set the FUNCTION switch to CK BAT: if the meter indicator falls outside the BAT region, the BATTERY needs charging. To recharge the battery, connect the analyzer to an ac power source as described in paragraph 2.4, and set the FUNCTION switch to CHARGE. The CHARGE lamp on the panel should light. The meter will indicate the relative battery voltage, as it does with the FUNCTION switch set to CK BAT.

About 16 hours will be required to recharge a battery whose voltage reads just outside the lower edge of the BAT region, that is, one which is fully discharged. If the battery has not been fully discharged, it should not be charged the full 16 hours. Charging for a period about equal to the discharge time is best. Do not overcharge the battery repeatedly or leave the battery on CHARGE continuously, as these practices will adversely affect the life of the battery.

### 3.1.2 LINE OPERATION.

When the analyzer is connected to an external ac line and the FUNCTION switch is set to FAST or SLOW, the instrument is operating on power from the line. The Type 1568 should normally be operated from the power line when it is available. The FUNCTION switch must be used to turn off the instrument.

NOTE

If the ac power is disconnected and the FUNCTION switch left in a position other than OFF, the analyzer will continue to operate on its internal battery. If the battery is more than fully discharged, it may have to be charged for an hour or more before even normal ac-line operation can be resumed.

## 3.2 CALIBRATION.

If if is desired that the meter of the Type 1568 read directly in volts, use the instrument's internal gain reference for calibration. To do this:

a. Select the frequency at which calibration is desired with the FREQUENCY MULTIPLIER and FREQUENCY dial. It is best to make the calibration at the center of the frequency range over which operation is intended.

b. Set the white dots on the METER RANGE switch and the MAX INPUT VOLTS switches straight up (at 12 o'clock).

c. Turn the FUNCTION switch to CAL.

d. Adjust the CAL control for a meter indication in the area marked CAL. It is not necessary to center the indicator in this area exactly.

For greatest accuracy, calibrate the instrument at each frequency at which it is used. This procedure, however, is not generally necessary.

NOTE

The calibration system in the Type 1568 is such that, with the FUNCTION switch set at CAL, the gain variation indicated by the meter is 10 times the actual gain variation. Therefore, if the analyzer is tuned while in the CAL mode, and the meter indicates, say, a gain variation of 10 dB, the real gain variation is only 1 dB.

## 3.3 CONNECTION TO INPUT.

### 3.3.1 GENERAL.

For the sake of convenience, two input connectors wired in parallel are supplied on the front panel: an open-circuit telephone jack and a three-terminal Cannon type XLR audio connector. Input impedance is 100 kΩ. The analyzer input is ac coupled, and its coupling capacitor will withstand up to 300 V dc. A series resistance protects the input circuit from short periods of signal overload. Long periods of signal input greater than 100 V, however, may damage the input circuits when the MAX INPUT VOLTS switch is set to 0.1 V.

Since the gain of the analyzer is high, input leads and plugs should be shielded, particularly if the input signal level is low or the impedance of the signal source is high.

### 3.3.2 THE TYPE 1560-P40 PREAMPLIFIER.

Terminal #2 of the three-terminal audio INPUT connector is wired to supply power for the Type 1560-P40. Use of this preamplifier is recommended when higher input impedance or higher sensitivity than that of the Type 1568 alone is required. It also allows operation of the wave analyzer remote from the signal source.

The harmonic distortion produced by the preamplifier is extremely low, although when the preamp is used near its maximum signal level, its distortion can be detected by the Type 1568. Since the preamplifier is usually necessary only at low signal levels (less than 0.1 V), its distortion is normally not a problem.

## 3.4 DYNAMIC RANGE AND INTERNAL NOISE.

The Type 1568 has the wide dynamic range necessary for a wide analyzing range in automatic recording of frequency spectra. The dynamic range of an analyzer is the range between overload and noise level at any one setting of the attenuator controls. Curves showing typical noise levels measured at the OUTPUT of the analyzer for each setting of the attenuator controls are shown in Figure 3-1. These curves are useful in determining analyzing range when the analyzer is used with a recorder. Levels are given in dB referred to the output voltage corresponding to a full scale meter deflection. Full scale meter deflection occurs at a level 10 dB below overload, so 10 dB must be added to the curves to find actual dynamic range.

## 3.5 DISTORTION MEASUREMENTS.

### 3.5.1 GENERAL.

Harmonic- or intermodulation-distortion products are usually measured as a percentage of the fundamental signal level. Alternatively, distortion can

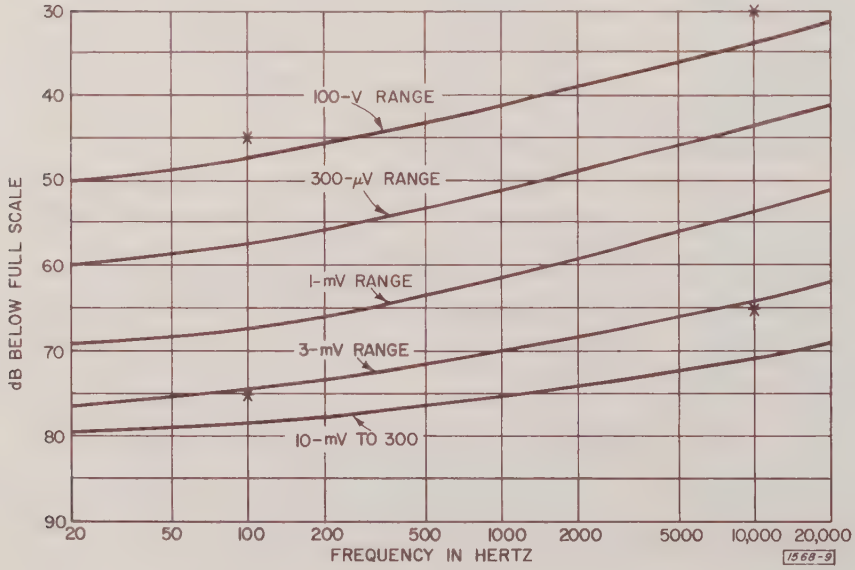



**Figure 3-1. Noise level vs frequency at OUTPUT jack for various analyzer attenuator settings.**

be measured in decibels referred to the level of the fundamental, or it can be determined by measuring the absolute voltage of each frequency component. An accessory, the Type 1568-2090 Detented Knob and Dial Assembly, is supplied to facilitate relative percent or dB measurements.

3.5.2 USING THE DETENTED KNOB AND DIAL ASSEMBLY.

Set up.

a. Remove the METER RANGE grey knob and clear plastic dial assembly after loosening the two set screws that secure it to its shaft.

b. Secure the Detented Knob and Dial Assembly to the shaft by tightening the one loose set screw on the assembly with a 3/32-in Allen wrench. The other set screw, which is already tight, holds the knob to the dial and should not be loosened. Phase the assembly so that any number, e.g., 100%, appears over the white area on the MAX INPUT VOLTS dial.

Measurement.

a. Set the METER RANGE switch (which now has a new knob and dial) fully clockwise. Set the MAX INPUT VOLTS switch fully counterclockwise.

b. Connect the signal to be analyzed to either INPUT connector, and set the FUNCTION switch to FAST.

c. Tune the analyzer to the frequency of the fundamental or reference component using the FREQUENCY MULTIPLIER and FREQUENCY controls.

d. Adjust the MAX INPUT VOLTS switch (black knurled dial) and CAL control for a meter indication of 10. It will probably be necessary to tune the FREQUENCY control more precisely once an on-scale meter indication has been obtained. If the level of the reference signal is less than 0.1 volt, it will be necessary to use the METER RANGE switch to obtain the full-scale meter indication. If this is the case, leave the MAX INPUT VOLTS switch in the fully clockwise position.

e. Hold the grey METER RANGE knob to prevent it from turning, and adjust the clear plastic dial so that 100% is over the white area.

f. Select the various distortion frequencies using the FREQUENCY MULTIPLIER and FREQUENCY dial and adjust only the METER RANGE switch for meter indications, fine-tuning the FREQUENCY control as required to obtain peak levels. The full-scale meter range in percent will be indicated on the METER RANGE dial by the white area of the MAX INPUT VOLTS dial.

**CAUTION**

**Improper use of the MAX INPUT VOLTS and METER RANGE switches can overload the analyzer preamplifier and introduce errors. The over-all input signal level should never exceed the level set by the MAX INPUT VOLTS switch (the black toothed dial). Once this switch is set to indicate a full-scale reading at the fundamental, never use the MAX INPUT VOLTS switch to increase gain; use only the METER RANGE switch (the grey knob and clear plastic dial) for this purpose. The procedure outlined above ensures that the analyzer is not overloaded, and it allows the entire potential analyzing range of the instrument to be realized.**

NOTE

At low frequencies (below 100 Hz) the bandwidth of the Type 1568 is extremely narrow, and, as a result, the transient response at these frequencies is very slow. Tuning in this range must therefore be done slowly and with great care if the true level of a frequency component is to be found.

## 3.6 ANALYSIS OF SIGNALS HAVING MANY STRONG COMPONENTS.

3.6.1 GENERAL.

When the signal to be analyzed has many strong components, the use of a level recorder is recommended. Manual analysis can be tedious and time consuming and subject to operator error. The following measurement procedure applies to both manual and automatic analysis. For specific recorder-analysis operating instructions refer to paragraph 3.8. If the actual voltage of each frequency component is required, calibrate the analyzer according to paragraph 3.2. If only relative voltage levels are of interest, use the Detented Knob and Dial Assembly according to paragraph 3.5.2.

3.6.2 SETTING THE MAX INPUT VOLTS SWITCH.

The first step in the analysis is to set the MAX INPUT VOLTS switch. The proper setting of this switch is central to an accurate analysis, since, if the analyzer circuits are overloaded because of improper setting, components may be produced that were not originally present in the input signal. The analyzer circuits can tolerate a peak amplitude slightly more than 13 dB above the level indicated by the MAX INPUT VOLTS switch. Adjust the MAX INPUT VOLTS (the black knurled dial) switch as follows:

Signal Level Known. If the input signal does not have a crest factor (crest factor = $\frac{\text{peak voltage level}}{\text{rms voltage level}}$) in excess of 10 dB, set the MAX INPUT VOLTS switch to the rms level of the signal. If the crest factor is greater than 10 dB, set the switch to a value that just exceeds half the peak signal voltage. (For small signals, the MAX INPUT VOLTS switch will be set to 0.1 V, that is, fully clockwise.)

Signal Level Unknown. If the rms level is not known, set the MAX INPUT VOLTS switch to a voltage one step higher than the estimated level. If little is known about the character of the input signal, it should be observed with an oscilloscope to find the peak voltage levels.

**CAUTION**

**Do not apply a signal whose rms voltage level exceeds 300 V to either analyzer INPUT jack.**

3.6.3 DETERMINING FREQUENCY COMPONENT LEVELS.

If they are known, select the various frequencies of the input signal, using the FREQUENCY and FREQUENCY MULTIPLIER controls. Adjust only the METER RANGE switch (the grey knob and clear plastic dial) for an on-scale meter reading, then fine-tune the FREQUENCY control for a peak reading. The meter indicates the rms voltage of the selected frequency component.

When the frequencies of the components are not known, search through the entire frequency range using both FREQUENCY controls and the METER RANGE switch.

3.6.4 HARMONICALLY RELATED COMPONENTS.

The bandwidth of the Type 1568 is always 1% of the selected frequency; therefore, it can not distinguish individual harmonics beyond the one hundredth. (The separation between harmonic number 100 and number 101 is about 1% of either frequency.) Actually, since the analyzer filter does not have an infinitely high attenuation rate near its band edges and since adjacent harmonics may differ significantly in level, the analyzer will usually separate about 50 harmonics. The analyzer is useful, none-the-less, in measuring harmonic components above the fiftieth when its limitations are understood.

It might be expected that the levels of components within the pass band of the filter would add in rms fashion. That is, a level L indicated by the meter would be composed of levels $L_1$, $L_2$, etc such that

$$L = \sqrt{L_1^2 + L_2^2 + L_3^2 + L_n^2}.$$

This would be the case if the meter detected the rms level of the signal. The actual meter circuit, however, employs an average detector which tends to indicate not the RMS sum of the components in the band, but rather the RMS value of a single component. Measuring the level of a harmonic even when other harmonics are included in the pass band, is thus simply a matter of tuning to that particular frequency and reading the meter.

The indication of the Type 1521 Graphic Level Recorder is more nearly the rms sum of the passed components. Details of interpreting this indication are discussed in paragraph 3.8.6.

3.6.5 MONITORING THE TYPE 1568.

Some types of input signal – short pulses, for example – will overload the analyzer output amplifier when a group of higher harmonics are tuned, even though the meter reads well below full scale. An oscilloscope connected to the OUTPUT jack of the analyzer can easily indicate the presence of such a condition.

## 3.7 ANALYSIS OF RANDOM SIGNALS.

3.7.1 GENERAL.

Many practical signals contain a certain amount of noise in addition to discrete frequency components. Indeed, some signals are composed of nothing but noise. Automatic analysis of this type of signal using a Type 1521 with the Type 1568 is essential if an extended range of frequencies is of interest.

3.7.2 PROCEDURE.

a. Calibrate the analyzer according to the directions in paragraph 3.2.

b. Use an average-responding or an rms voltmeter to determine the approximate over-all level of the input signal. Set the MAX INPUT VOLTS switch to a level just higher than the measured signal level, except when it is suspected that the signal has a high crest factor. In this case, use an oscilloscope to observe the signal, and follow the instructions of paragraph 3.6.2 to set the MAX INPUT VOLTS switch.

c. Connect the signal to the INPUT of the analyzer and adjust only the METER RANGE switch (the grey knob and clear plastic dial) to obtain an on-scale meter indication.

d. Set the FUNCTION switch to SLOW to minimize variations in the meter indication. This is especially necessary at low frequencies where the analyzer's narrow bandwidth produces fluctuations requiring long meter-averaging time. Below 200 Hz take several readings at intervals of at least 5 seconds and average these to find an accurate time average of the noise.

e. When the level of a band of noise has been measured, correct the reading of the analyzer's average-responding meter to obtain the rms noise level by adding 1 dB (about 12%) to the reading.

3.7.3 SPECTRUM LEVEL.

The spectrum level of a noise signal is the level that would be measured at any frequency by a filter having an effective bandwidth for noise of 1 Hz. A noise spectrum is often specified in terms of its spectrum level so that data taken by different types of analyzers can be readily compared.

The effective bandwidth for noise of the filter in the Type 1568 Wave Analyzer is 1.3%. Because the bandwidth of the analyzer varies directly with frequency, the correction to spectrum level is also proportional to frequency. The curve of Figure 3-2 shows the number of decibels that must be added to or subtracted from the measured rms level to find the spectrum level. This conversion to a 1-Hz bandwidth is meaningful only if the spectrum is essentially uniform within the measured band and if the noise does not contain prominent pure-tone components.

## 3.8 USING THE TYPE 1568 WITH THE TYPE 1521.

3.8.1 GENERAL.

Instructions for the interconnection of the Type 1568 with the Type 1521 are in paragraph 2.4. These

instructions assume a general familiarity on the part of the user with the operation of the analyzer and the recorder as individual instruments.

3.8.2 CHOICE OF ACCESSORIES.

Motor. The Type 1521 should be ordered with a Type 1521-P23 Medium Speed Motor for 60-Hz power-line operation installed (or a Type 1521-P24 for 50-Hz power line). The recorder-speed range possible with the medium speed motor is ideal for use with the analyzer. The high-speed motor normally supplied with the recorder does not permit it to run slowly enough to be used with the lowest two ranges on the analyzer.

Chart paper. Type 1521-9475 Chart Paper should be ordered with the recorder. This paper has a frequency scale length of 10 inches/decade. The full amplitude scale is 4 inches for 20, 40, or 80 dB, depending on the recorder-potentiometer used.

Potentiometer. The Type 1521-P2 40-dB Potentiometer is best for most analyzer-recorder operation. When more than 40 dB of the spectrum is of interest, use the 80-dB Potentiometer (Type 1521-P3).

3.8.3 CALIBRATION OF THE COMBINATION.

If the Type 1521-P2 40-dB Potentiometer is used, it will probably be convenient to adjust the gain of the recorder so that it gives a full scale indication when the analyzer meter reads full scale. This is done as follows:

a. Set the recorder DAMPING control so that recorder overshoot is about one chart division, referring to the instructions in paragraph 3.2 of the Type 1521 instruction manual. This setting is not critical for recorder-analyzer applications.

b. Set the analyzer FUNCTION switch to CAL, and adjust the MAX INPUT VOLTS switch and the METER RANGE switch so that the white dots on these controls are both at 12 o'clock.

c. Set the analyzer frequency to 1 kHz (the recorder must be in NEUTRAL) and adjust the analyzer CAL control for a meter indication of 10.

d. Adjust the recorder ATTENUATOR and CAL control for a full-scale pen setting (recorder ATTENUATOR setting will be 10 or 20 dB).

e. Readjust the analyzer CAL control for a meter indication in the CAL area.

f. When the 80-dB potentiometer is used, set the pen to indicate 20 db below full scale when the analyzer reads full scale.

NOTE

The analyzer cannot drive the recorder full scale when the 80-dB potentiometer is used: the analyzer will overload about 10 dB below full scale on the recorder (corresponding to 10 dB above full scale on the analyzer) when the OUTPUT signal is sinusoidal.

3.8.4 CHOICE OF SWEEP SPEED AND WRITING SPEED.

The narrow filter in the Type 1568 cannot respond instantaneously to a signal, nor can the recorder pen, which is in effect a narrow filter also. These two factors determine the choice of sweep speed and writing speed for the recorder-analyzer combination.

NOTE

When the controls of the Type 1521 and of the Type 1568 are set as described in paragraph 3.8.5, the chart paper and the FREQUENCY dial are synchronized. Since the chart paper is calibrated with 10 in per frequency decade, the rate at which the analyzer frequency is swept will always be related to the chart speed as follows:

Sweep Rate (decade/min) = 0.1 x Chart Drive Speed (IN/MIN). Since the analyzer sweep speed is the factor that is limited, while the chart-drive speed is the factor that is actually set by the controls on the Type 1521, the convention of discussing sweep speed in in/min will be adopted in this section.

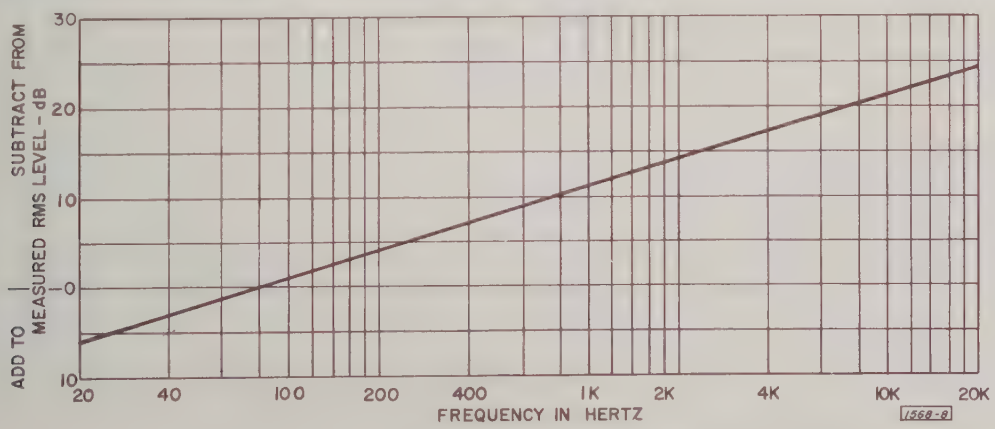



Figure 3-2. Correction vs frequency for rms noise spectrum measured by the Type 1568 to give the spectrum level of a signal.

## TABLE 3-1
### Maximum Sweep Speed and Maximum Writing Speed for each Frequency Range

| FREQUENCY RANGE (hertz) | MAXIMUM SWEEP SPEED (use medium-speed motor) (inches/minute) | MAXIMUM WRITING SPEED (inches/second) |
|---|---|---|
| 20 - 63 | 0.5 | 10 |
| 63 - 200 | 1.5 | 10 |
| 200 - 630 | 5 | 20 |
| 630 - 2000 | 15 | 20 |
| 2000 - 6300 | 15 | 20 |
| 6300 - 20000 | 15 | 20 |

If the analyzer is swept too rapidly through a spectrum line, the line will appear to have the wrong frequency and amplitude, and the filter bandwidth will seem widened and distorted. Figure 3-3 shows this effect. Each curve was plotted with a writing speed of 10 in/s. The curve with the higher peak shows the correct amplitude and frequency of its component. It was recorded with a sweep speed of 0.5 in/min. The other curve was plotted with a sweep speed of 5 in/min, ten times faster than the maximum speed allowable for the frequency range covered in this plot.

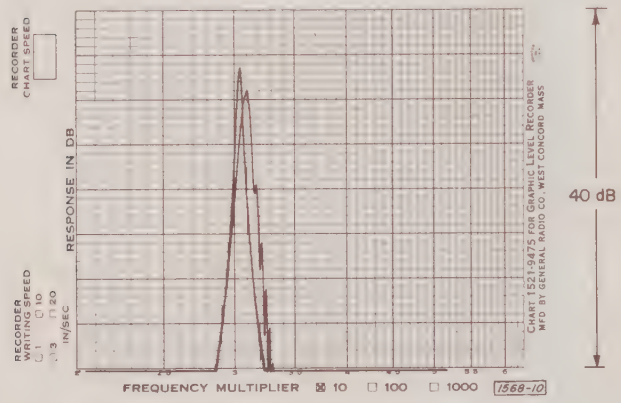



Figure 3-3. Effects of too rapid sweep speed.

Figure 3-4 shows the effect of using a writing speed that is not high enough for the sweep speed used. Here each curve was plotted using a sweep speed of 15 in/min, a speed slow enough for the top two frequency ranges of the analyzer. The curve with the higher level was recorded with a writing speed of 20 in/s, while the other curve, which shows incorrect frequency and level, was recorded with a writing speed of 3 in/s.

Table 3-1 shows the maximum sweep speed and the maximum writing speed for each analyzer frequency range. Table 3-2 shows the minimum writing speed for each sweep speed.

Always use the slowest possible writing speed when recording with the Type 1521. When plotting a spectrum over the entire 20-Hz to 20-kHz frequency range with the recorder unattended, use a sweep speed of 0.5 in/min and a writing speed of 1 in/s. Total analysis time will be 70 minutes. If an unattended recording is started at 63 Hz, a sweep speed of 1.5 in/min can be employed, and total time will be reduced to 23 minutes. This faster sweep speed and writing speed are permissible only if the spectrum is composed mostly of discrete frequency components.

## TABLE 3-2
### Minimum Writing Speed for each Sweep Speed

| SWEEP SPEED (inches/minute) | MINIMUM WRITING SPEED (inches/second) |
|---|---|
| 0.5 | 1 |
| 1.5 | 3 |
| 5 | 10 |
| 15 | 10 |

The bandwidth of the analyzer at low frequencies is much narrower than necessary for practical random-signal applications. Bandwidth requirements are determined by the fineness of detail expected in a spectrum, and "spikes" as narrow as a few tenths of a cycle in a random noise spectrum are very unlikely. Moreover, the slowest recorder writing speed is not

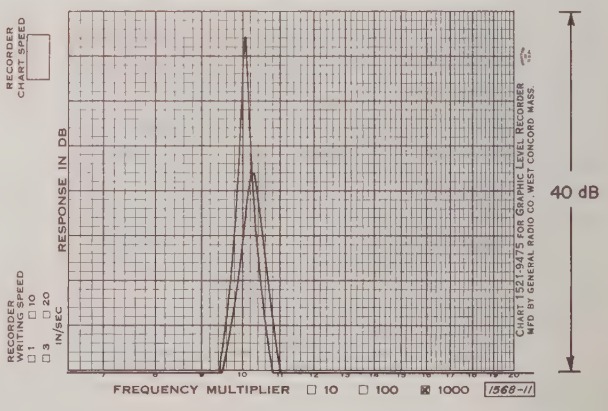



Figure 3-4. Effects of too slow recorder writing speed.

slow enough for a good plot of a noise band narrower than about 2 Hz (the bandwidth of the analyzer at 200 Hz). For this reason, use of the Type 1521 and Type 1568 to analyze noise at frequencies below 200 Hz is not recommended.

Above 200 Hz a good time average of noise levels will require the slowest possible sweep speed (0.5 in/min) and writing speed (1 in/s) except possibly in the top two frequency ranges, where a 1.5-in/min sweep speed and a 3-in/s writing speed may yield an acceptable plot. Figure 3-5 shows a spectrum-plot of pink noise recorded over the entire frequency range with a sweep speed of 0.5 in/min and a writing speed of 1 in/s. Note the large excursions in the lower two ranges.

To save time while plotting line-component spectra the user can increase writing and sweep speeds by one position manually each time the analyzer frequency range increases. The change can be conveniently accomplished when the analyzer is between ranges.

3.8.5 OPERATION.

a. Set the external-motor switch on the Type 1521-P10B Drive Unit toward the rear of the instrument.

b. Set the clutch level on the drive unit to IDLE.

c. Set the right-hand chart speed lever to N (neutral). (To release the levers for adjustments, pull them out.)

d. Turn the MANUAL SET control to set the pen over the "2" line on the chart paper (FREQUENCY of 20 Hz, 200 Hz, etc), or over the "6.4" line for the red analyzer frequency ranges.

e. Set the FREQUENCY dial to 2 (or 6.4 as required) and then the Drive Unit clutch level to NON SLIP. The chart paper and analyzer are now synchronized.

f. Set the analyzer FREQUENCY MULTIPLIER to the desired range and MULTIPLIER SWITCHING to AUTO.

g. Adjust the MAX INPUT VOLTS switch in accordance with the over-all input signal level (refer to paragraphs 3.6.2 and 3.7.2, step b, for details of this procedure).

h. If the approximate level of the largest component(s) of the input signal is known, set the METER RANGE switch to indicate a meter range just higher than this level. If the component levels are not known, set the METER RANGE switch fully clockwise, and select the writing and sweep speeds in accordance with paragraph 3.8.4. The chart-drive speed indicated by the left-hand lever multiplied by the number indicated by the right-hand clutch lever is the actual speed. (Turn the CHART DRIVE switch to FWD before moving the right-hand lever to X1 or X10). Make a dry (with the pen lifted from the paper) run to determine the maximum levels in the spectrum. If the peaks in the spectrum are not high enough to register on the recorder, turn the METER RANGE switch four positions counterclockwise and repeat the run.

i. Adjust the METER RANGE switch so the maximum level will indicate near full scale and plot the spectrum.

3.8.6 INTERPRETING THE RECORDER INDICATION.

The rms detector in the Type 1521 Graphic Level Recorder will correctly sum the level of sev-

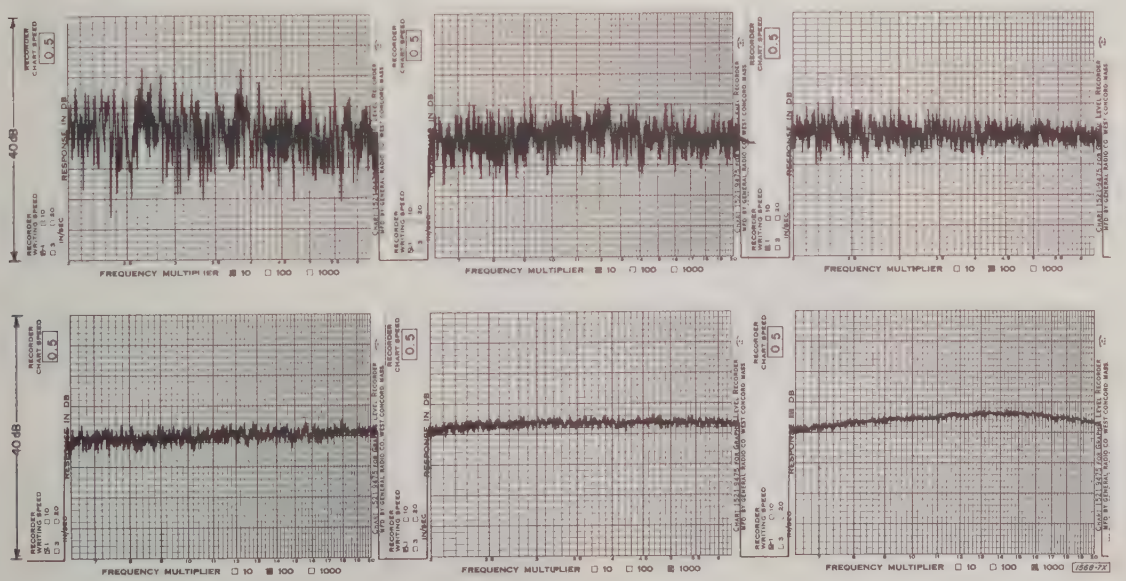



**Figure 3-5. Spectrum plot of signal generated by a pink noise generator, recorded by the Type 1568 - Type 1521 combination.**

eral closely spaced line components. Such a phenomenon is likely, for example, in the spectrum of a pulse or a tone burst. To get an accurate indication of these, the recorder WRITING SPEED switch must be set so that the LOW FREQUENCY CUTOFF indication of this control is less than the separation in frequency between adjacent components.

For example, when plotting the spectrum of a short pulse having a 20-Hz repetition rate, set the writing speed to 3 in/s and the sweep speed to 1.5 in/min. Above 1000 Hz, the envelope, rather than the components, of the pulse spectrum will be plotted. To determine the level of an individual component at a given frequency when there are several components in the same band use the expression

$L = 10\ L_T \sqrt{f_o/f}$, where

$L$ = level of individual component

$L_T$ = level indicated by the recorder

$f_o$ = repetition rate (frequency separation between components)

$f$ = frequency of component having level L.

In the case of a pulse or burst, and in that of many other signals, several factors limit the number of harmonics that can be measured with the recording wave analyzer to about 300.

SECTION 4

# APPLICATIONS

## 4.1 GENERAL.

To be classed as a wave analyzer, an instrument must have a very narrow bandwidth in order to allow the separation of closely spaced discrete frequency components. The filter must also have a high initial cut-off rate and high attenuation so that it can discriminate small frequency components in the presence of larger ones. It should be capable of "seeing" at least 70 dB into a spectrum. Further, the self-generated distortion of the filter should be so low that the analyzer, under normal conditions, cannot detect it.

The constant-percentage-bandwidth Type 1568 Wave Analyzer, and most constant-bandwidth analyzers qualify. The relative advantages of the Type 1568 and constant-bandwidth analyzers are pointed out in this section.

## 4.2 ANALYSIS OF SIMPLE PERIODIC SIGNALS.

Harmonic distortion is readily measured with either type of analyzer. The second harmonic, being closest to the fundamental, is the most difficult to discriminate. When the analyzer is tuned to the second harmonic, attenuation of the fundamental must be sufficient to reduce its level to less than that of the harmonic. Half-frequency attenuation in the Type 1568 is at least 75 dB independent of the frequency to which it is tuned.

The Type 1568, which will separate about 50 harmonics, is adequate for most purposes, though the number of harmonics separated depends somewhat on spectrum shape and accuracy requirements.

When many components of a simple periodic signal are to be resolved, there is an advantage in using a constant-bandwidth analyzer and a linear frequency scale for recording. The separate harmonics are equally spaced in frequency; so, if a constant-bandwidth analyzer has sufficient attenuation to resolve the first few harmonics (it may not at low frequencies), it will resolve all harmonics within its amplitude and frequency limits. Since the bandwidth of the Type 1568 increases with frequency, eventually it will not be able to separate individual components at higher frequencies and will instead display the envelope of the spectrum. Figure 4-1 illustrates this effect. The envelope may be the only information required, since the frequency of each component would be known.

## 4.3 ANALYSIS OF MODULATED SIGNALS.

A periodic signal modulated with a simple periodic signal also has equally spaced components, the spacing being determined by the fundamental frequency of the modulating signal. Whether the Type 1568 can resolve a carrier and side bands depends on the ratio of the carrier frequency to the lowest frequency component of the modulating signal. As a rule of thumb, the ratio must be less than 50:1.

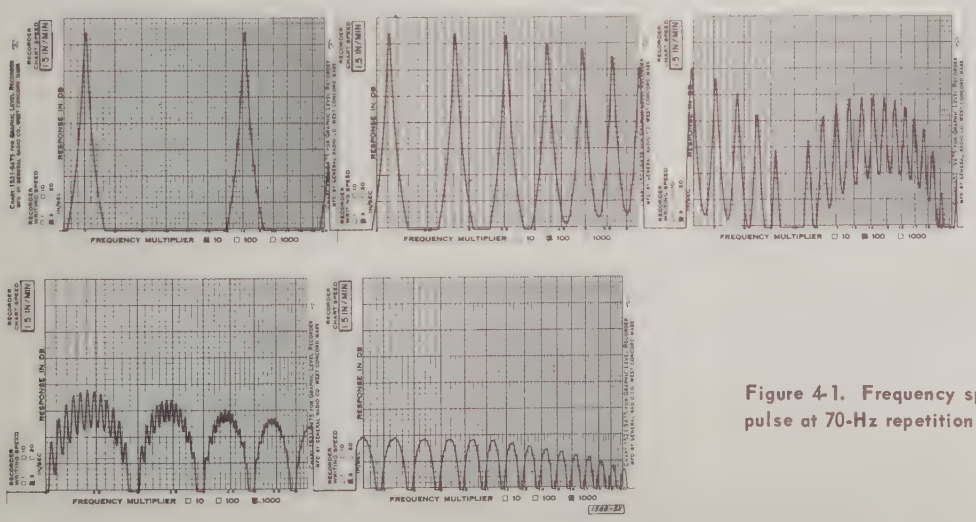
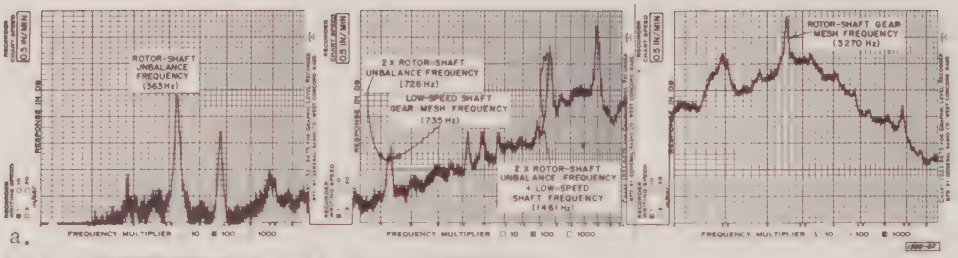



Figure 4-1. Frequency spectrum analysis of a 1.0-ms pulse at 70-Hz repetition rate.


a.
ROTOR-SHAFT UNBALANCE FREQUENCY (363 Hz)
2 X ROTOR-SHAFT UNBALANCE FREQUENCY (726 Hz)
LOW-SPEED SHAFT GEAR MESH FREQUENCY (735 Hz)
2 X ROTOR-SHAFT UNBALANCE FREQUENCY + LOW-SPEED SHAFT FREQUENCY (1461 Hz)
ROTOR-SHAFT GEAR MESH FREQUENCY (3270 Hz)
FREQUENCY MULTIPLIER

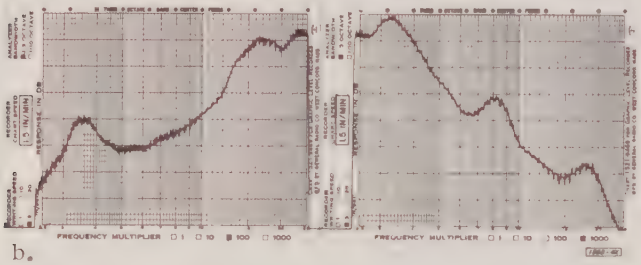
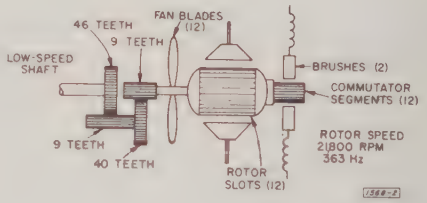



Figure 4-2. Chart records of vibration acceleration spectrum of a motor and gear train assembly (see sketch). (a) A 1%-bandwidth analysis, taken with the Type 1568. (b) A 1/3-octave analysis.




## 4.4 ANALYSIS OF DISCRETE COMPONENTS AT LOW FREQUENCIES.

The bandwidth of the Type 1568 is reduced to 0.2 Hz at its low-frequency limit – much narrower than even the narrowest constant-bandwidth analyzers. Thus at low frequencies it can separate components spaced only a fraction of a hertz apart. Further, in this range it does not have the annoying frequency drift usually associated with heterodyne instruments, and its frequency accuracy and dial resolution are far superior to that type of analyzer.

## 4.5 ANALYSIS OF NOISE SPECTRA.

Though the detail required in the analysis of noise spectra that contain no important discrete components does not warrant the use of a bandwidth as narrow as that of the Type 1568, the instrument can be used for this purpose. An automatically recorded analysis is usually desirable, but not mandatory. A slow meter speed is incorporated in the Type 1568 to facilitate manual analysis.

## 4.6 ANALYSIS OF SOUNDS PRODUCED BY MACHINERY.

The Type 1568 Analyzer is well-suited for the production of fine spectrum analyses of the sound and/or vibration produced by machinery. Such an analysis will shown various discrete frequencies and resonances which can then be related to motion within the machine. Once the source of noise within a machine has been identified, the noise can be eliminated or reduced. This is often desirable for a variety of reasons[1] (effect on man, mechanical failure, excessive wear, etc).

Figure 4-2 shows the vibration acceleration spectrum measured by the Type 1568 – Type 1521 combination on the housing of a machine employing a high-speed universal motor and gear train. For comparison, a one-third-octave spectrum is also shown. The various sources of vibration which are identified include frequencies caused by motor armature, unbalance, and gear teeth meshing. The large component at 3270 Hz is critical from the standpoint of its effect on man, since it is in the frequency range where hearing is most acute. Reducing the level of the component by improving the gear design would markedly reduce the loudness and speech interference level of the sound. Various other components may be found critical when other aspects of the noise problem are considered. For example, bearing wear could be reduced by improving armature balance.

## 4.7 MIL-STANDARD-740B (SHIPS).

Mil-Standard-740B (SHIPS) (Airborne and Structure-borne Noise Measurements and Acceptance Criteria of Shipboard Equipment) allows a narrow-band vibration analysis in the frequency range below 500 Hz when requirements cannot be met by a one-third-octave analysis. The acceptance limits are the same in either case. A narrow band is defined as "...a band whose width is not less than one percent nor more than 8% of the band center frequency." This specification makes the Type 1568 an important tool for acceptance testing in accordance with the standard.

## 4.8 FREQUENCY MEASUREMENT OF A COMPONENT.

The analyzer can be used to select a signal component whose frequency is to be measured more accurately than the accuracy of the FREQUENCY dial will allow. The signal at the OUTPUT jack is used to drive a Type 1142 Frequency Meter and Discriminator or a counter (such as the Type 1150 Digital Frequency Meter or the Type 1151 Digital Time and Frequency Meter ).

[1] Arnold Peterson, *Vibration: Problems, Measurements and Control*, General Radio Preprint B-22.

SECTION 5

# PRINCIPLES OF OPERATION

## 5.1 GENERAL.

The general principles of operation are discussed in paragraph 1.2. In this section the various component parts of the analyzer will be described (see the block diagram, Figure 5-1). The principles involved will be discussed to the extent that they may help the operator to use the instrument more effectively and to maintain proper operation.

## 5.2 INPUT.

The INPUT drives three cascaded attenuators, the first two of which are operated by coaxial switches (S101 and S102) and act together to set the meter range of the analyzer. The first attenuator also determines the maximum voltage that can be applied to the analyzer and is adjusted by the black knurled dial labeled MAX INPUT VOLTS. The second forms part of the

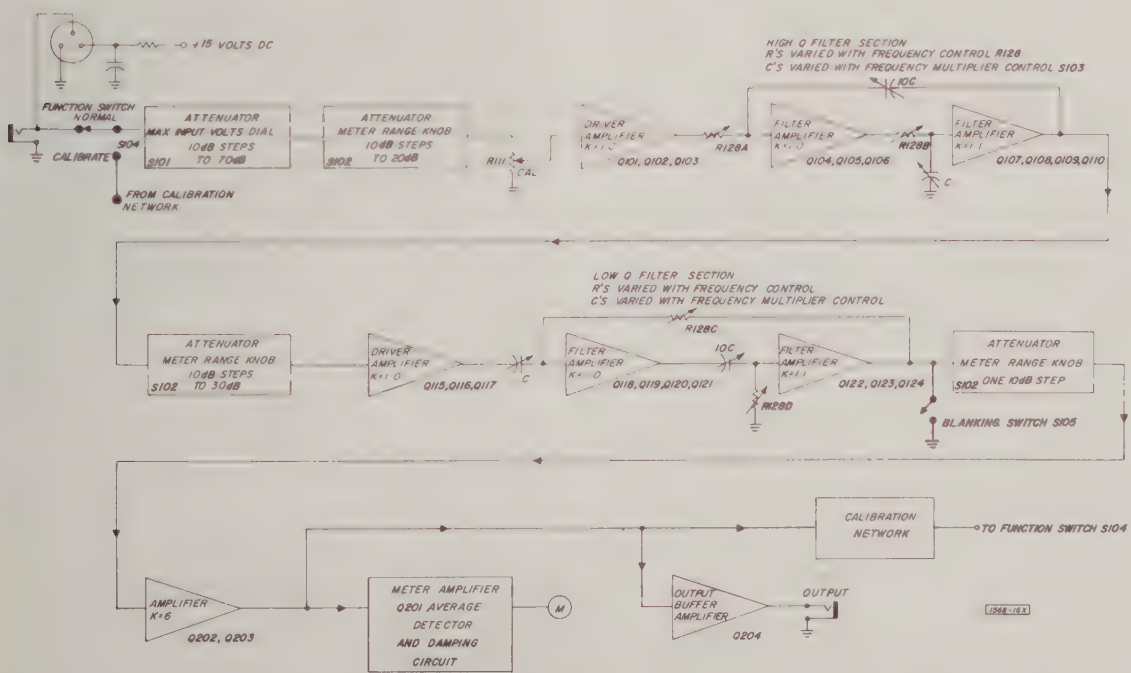



Figure 5-1. Block diagram of the Type 1568.

analyzing attenuator and is adjusted by the METER RANGE clear plastic dial and grey knob. The last attenuator is the continuously adjustable CAL control which is used for amplitude calibration. The attenuators are arranged to present a nearly constant impedance of 100 kΩ to the INPUT connectors.

## 5.3 FILTER.

The filter consists of an isolated cascade of two active, synchronously tuned, RC-resonant sections, the "High Q" section and the "Low Q" section. Maximum sensitivity to tuning potentiometer tracking error between sections would occur if the Q's of the filter sections were equal (Q = 1/filter-section dissipation factor), hence the difference between sections. The audio range (20 Hz to 20 kHz) is covered in six bands, each spanning half a decade (range of 3.16 to 1). Close tolerance capacitors (C105 - C110, C113 - C118, C124 - C129, and C132 - C137) are switched by S103 to change ranges. Within any one range, the instrument is tuned by means of a four-gang potentiometer, R128, whose resistance-versus-angle characteristic produces a logarithmic frequency scale on the FREQUENCY dial.

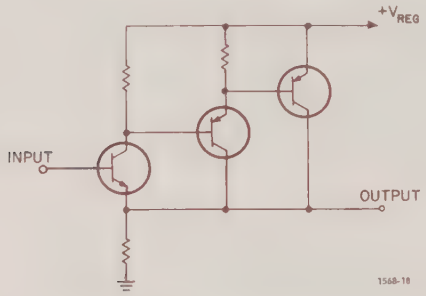



**Figure 5-2. Basic filter amplifier simplified schematic diagram.**

In the design of filter sections such as those in the Type 1568, a trade-off between sensitivity to component-value changes (and to tuning-potentiometer tracking errors) and sensitivity to amplifier gain is possible. The Type 1568 filter sections are designed

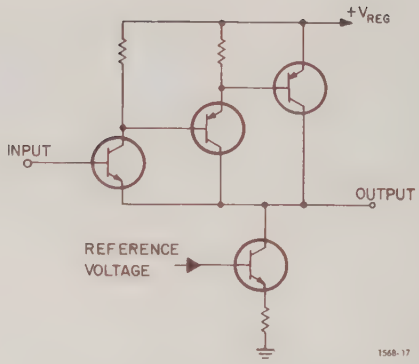



**Figure 5-3. Filter amplifier with constant current source or emitter load.**

for low sensitivity to tracking errors in tuning potentiometer (and also to drift in all passive components). The result is a high sensitivity factor to change in the gain of the amplifier. But the unity- or near unity-gain series-voltage-feedback amplifiers in the filter sections have extremely high gain stability. This stability, as well as a very high ratio of input to output impedance is attained through the use of one NPN and two PNP transistors in the configuration shown in Figure 5-2. This basic amplifier circuit is used for the two driver amplifiers as well as for the four filter amplifiers. A constant-current source (Q110, Q121) is added in place of the emitter resistor (see Figure 5-3) in two of the amplifiers. The constant-current source maintains the stray loading impedance on the network connected to the amplifier input to be a constant fraction of the network's impedance as the filter is tuned within each range. This further reduces variation in filter Q with tuning.

Constant gain around the filter feedback loop for each frequency range is arranged for by the inclusion of a trimming resistor for each frequency range (R178 - R183 and R134 - R139) in the emitter circuit of one of the amplifiers in each filter section. These resistors are switched along with the range-determining capacitors by the FREQUENCY MULTIPLIER switch, S103.

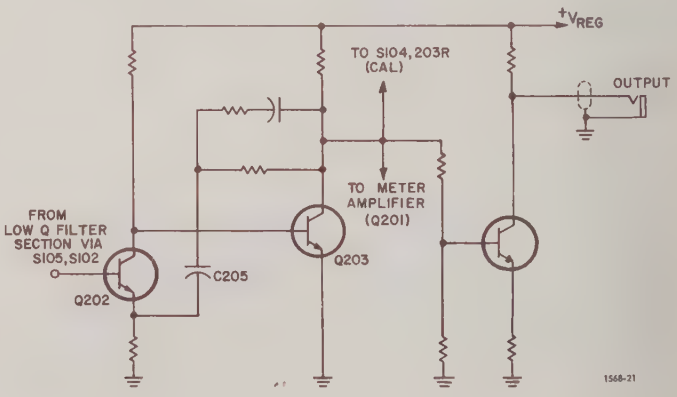



**Figure 5-4. The filter output amplifier.**

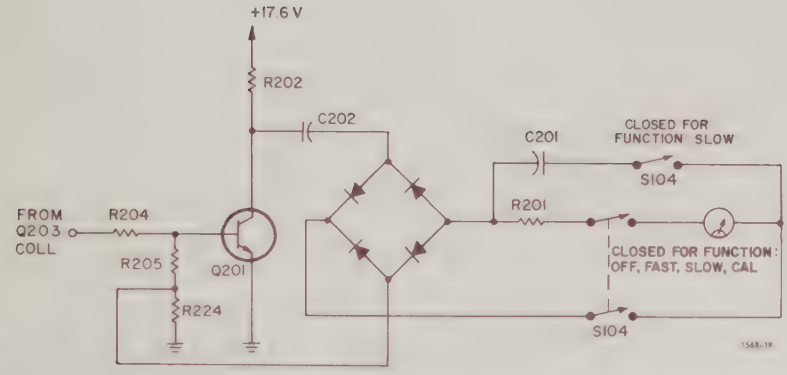



Figure 5-5. The Type 1568 meter circuit.

Each filter section has its own two-transistor series-type voltage regulator (Q111, Q112 and Q113, Q114), since the sections require low-impedance power supplies. This arrangement also prevents one section from interacting with the other through a common power-supply connection.

As indicated by the block diagram, sections of the analyzing attenuator (controlled by the METER RANGE switch S102) are included between the two filter sections and after the last section. Separation of the analyzing attenuator into three sections maintains dynamic range over a wide range of input levels.

## 5.4 OUTPUT.

A final amplifier consisting of Q202 and Q203 amplifies the filtered signal for application to the meter circuit and output buffer (see Figure 5-4). The buffer amplifier isolates the OUTPUT terminal so that performance of the Type 1568 is not affected by the loading of this terminal.

The filtered signal reaches the filter-output amplifier via S105, which grounds the input of the output section each time the FREQUENCY dial (filter-tuning potentiometer) is swept through its blank region. This switching facilitates use of the Type 1568 with the Type 1521 when the automatic FREQUENCY-MULTIPLIER-switching feature is used, as it prevents range-changing transients from appearing at the OUTPUT jack. The meter amplifier Q201, shown in Figure 5-5 drives a diode-bridge meter rectifier. This bridge instead of being connected between the amplifier and ground, is returned to the amplifier input via current divider R205 and R224. This negative feedback compensates for the effects of the amplitude non-linearity of the average-detector diode circuit.

## 5.5 CALIBRATOR.

The feedback-type amplitude calibrator (see Figure 5-6) operates as follows: When the FUNCTION switch is set to CAL, a signal from the filter-output amplifier is fed to the input of the filter through a limiter and reference attenuator (R222 and R223). When the gain of the analyzer is adjusted, by means of the CAL control, to equal the loss in the feedback path, the system oscillates, signifying that the instrument is calibrated. The frequency of oscillation is determined by the center frequency of the filter, and this calibration can be made at any selected frequency.

## 5.6 POWER SUPPLY.

A simplified diagram of the power supply is shown in Figure 5-7. The battery supplied is a rechargeable nickel-cadmium unit which also serves as a ripple filter for line operation. As shown, the built-in charger operates from the ac line.

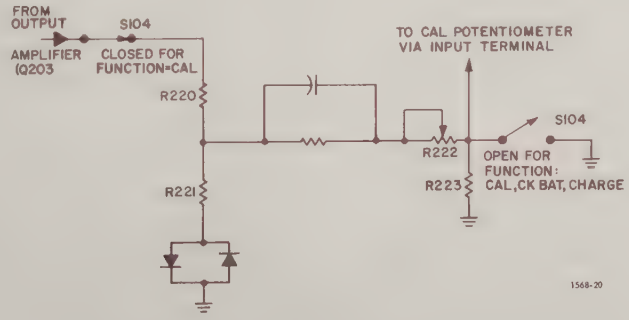



Figure 5-6. The Type 1568 calibration network.

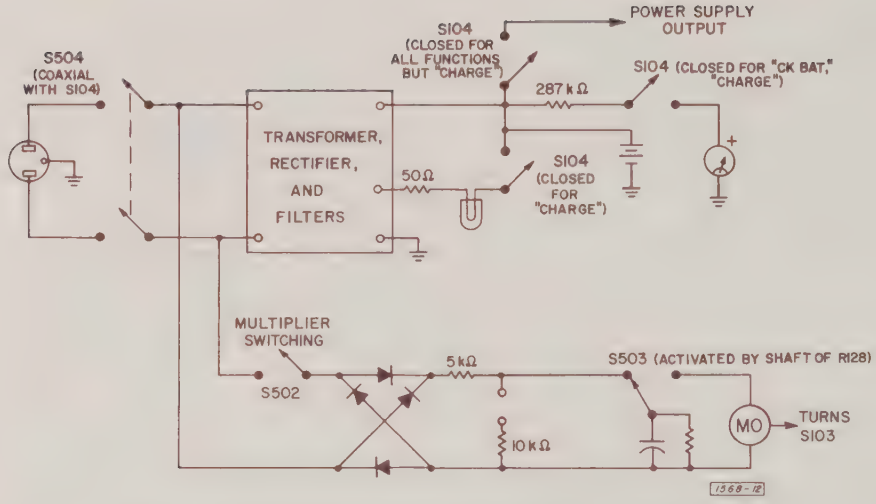



Figure 5-7. Simplified schematic diagram of the power-supply circuits.

*SECTION* 6

# SERVICE AND MAINTENANCE

## 6.1 WARRANTY.

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, District Office, or authorized repair agency personnel, will be repaired, or at our option, replaced without charge, except for tubes or batteries that have given normal service.

## 6.2 SERVICE.

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial, type, and ID numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest District Office requesting a "Returned Material Tag". Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

## 6.3 ACCESS TO COMPONENTS.

To obtain access to the components of the wave analyzer, remove the four 10-32 screws holding the instrument to its case, then lift the panel and instrument out of the case and place it front down on the bench. The power supply etched-board circuit assembly is mounted on hinges so that it can be swung upwards to reveal the wiring and components below. This requires only the removal of the two screws at the top of the board.

The output amplifier circuit assembly is mounted on a plug-in etched-board, which can be easily pulled out with the removal of the two screws at the top of the board.

The High-Q and Low-Q etched-board circuit assemblies, which are also mounted on plug-in boards, and the control boards, which contain potentiometers R134 through R139 and R178 through R183, are located behind the plate in the center of the instrument. To obtain access to these, remove the four screws on the top of the plate and the one small screw holding the plate to the side of the instrument, and lift off the plate. S103 and the capacitor boards are also located beneath this plate. Figure 6-1 will aid in the location of the various switches in the Type 1568.

## 6.4 MINIMUM PERFORMANCE SPECIFICATIONS.

The following procedures are recommended for incoming inspection or periodic checks. The test described will reveal whether the instrument meets catalog specifications. Instructions for calibration of the Type 1568 are contained in paragraph 6.5.

### 6.4.1 EQUIPMENT REQUIRED.

Sine-wave Oscillator.
Range: 20 Hz to 20 kHz
Output: 1.5 V into 600-Ω load (10 mW)
The Type 1309 Oscillator is recommended.

Frequency Meter.
Range: 20 Hz to 20 kHz
Accuracy: greater than 0.2%
The Type 1191 Counter or the Type 1142 Frequency Meter and Discriminator is recommended.

AC Voltmeter.
Range: 0 to 10 V
Accuracy: ±2%
The Type 1806 Electronic Voltmeter is recommended.

Attenuator.
Impedance: 600 Ω
Attenuation: 100 dB in 0.1-dB steps
The Type 1450-TB Decade Attenuator is recommended.

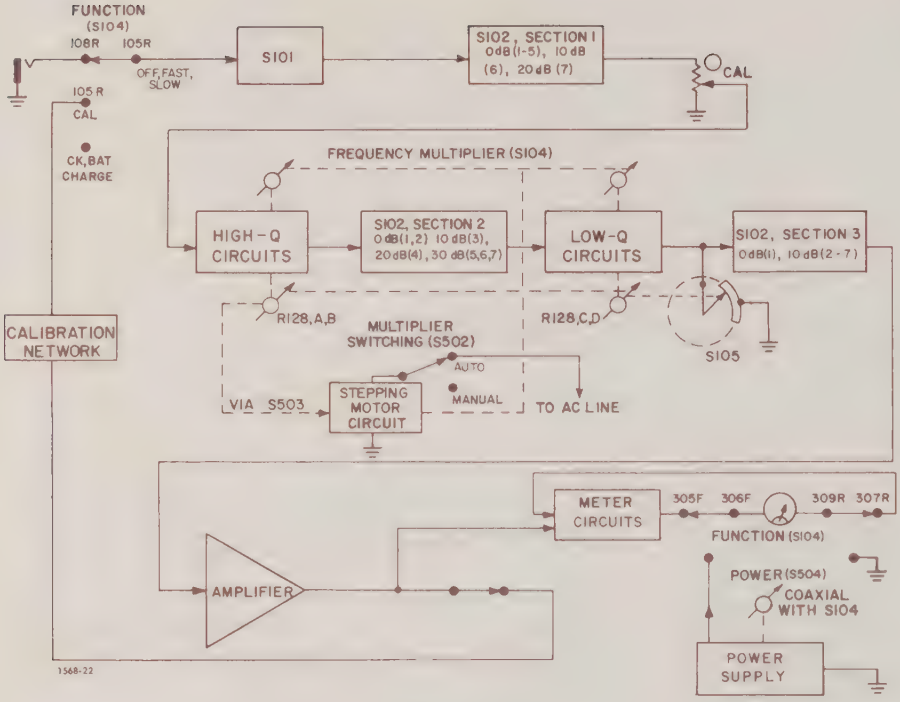



**Figure 6-1. Switch locations in the Type 1568. Numbers in parentheses in filter sections indicate switch position from fully clockwise (1) to fully counterclockwise (7).**

Oscilloscope.

Input Impedance: 1 MΩ
Vertical sensitivity: calibrated

The Tektronix Model 503 Oscilloscope is recommended.

600-Ω Resistor.

The Type 500-G Resistor is recommended.

10-kΩ Resistor.

Patch Cords.

3 Double Plug to Double Plug (Type 274-NPM is recommended.)

2 Double Plug to Telephone Plug (Type 1560-P95 is recommended.)

1 Cannon 3-connector Plug to Telephone Plug. (Type 1560-P99).

NOTE

The sine-wave output of the Type 1309 Oscillator is to be used throughout the following tests. All OUTPUT settings are given in volts, rms.

6.4.2 PRELIMINARY TESTS.

Meter Accuracy. Assemble the test equipment as shown in Figure 6-2.

Set: Type 1309: FREQUENCY - 1 kHz, OUTPUT - 1V.
Type 1450-TB: Attenuation - 22 dB.

Type 1568: FUNCTION - FAST, FREQUENCY - 1 kHz, MAX INPUT VOLTS - 0.1, METER RANGE - 100 mV/-20.

Adjust the Type 1568 FREQUENCY control for a peak, then adjust the CAL control for a reading of 0 on the

**TABLE 6-1**
**Meter Check**

| *Setting of Type 1450-TB Attenuator (dB)* | *Meter Indication of Type 1568* |
|---|---|
| 20 | +2 |
| 30 | -8 |
| 37 | -15 |

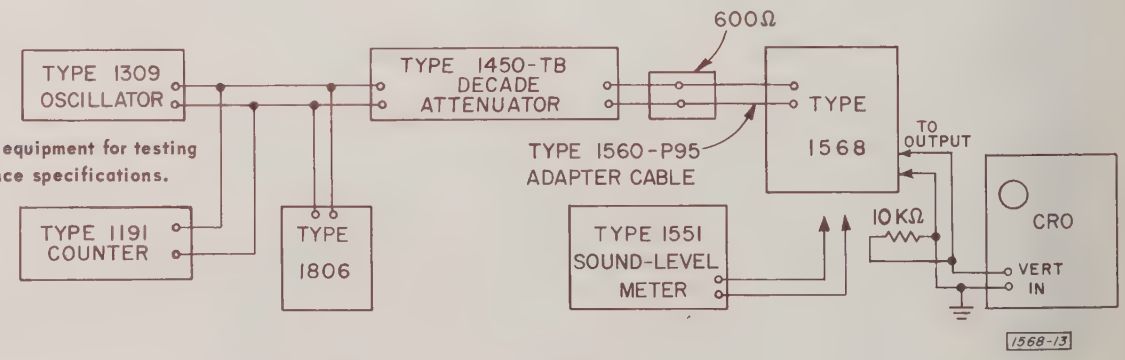



**Figure 6-2. Set up of equipment for testing minimum performance specifications.**

## TABLE 6-2
### Attenuation Check

| *Setting of Type 1450-TB Attenuator (dB)* | *Max Input Volts* | *Meter Range* |
|---|---|---|
| 70 | 0.1 | 1 mV/-60 |
| 60 | 0.3 | 3 mV/-50 |
| 50 | 1 | 10 mV/-40 |
| 40 | 3 | 30 mV/-30 |
| 30 | 10 | 100 mV/-20 |
| 20 | 30 | 300 mV/-20 |
| 10 | 100 | 1 V/0 |
| 0 | 300 | 3V/+10 |
| 60 | 0.1 | 3 mV/-50 |
| 50 | 0.1 | 10 mV/-40 |
| 40 | 0.1 | 30 mV/-30 |
| 30 | 0.1 | 100 mV/-20 |
| 80 | 0.1 | 300 μV/-70 |
| 90 | 0.1 | 100 μV/-80 |

DBM scale. Test whether the Type 1568 meter corresponds to the settings of the attenuator (Table 6-1). The meter readings should be within ±0.2 dB of those specified in Table 6-1. Repeat the test with the FUNCTION switch set to SLOW. The results should be the same, except that the meter will be highly damped.

Attenuation. Use the set-up of Figure 6-2.

Set: Type 1309: FREQUENCY - 1 kHz, OUTPUT - 2.5 V.
Type 1450-TB: Attenuation - 70 dB
Type 1568: FUNCTION - FAST, MAX INPUT VOLTS - 0.1, METER RANGE - 1 mV/-60.
Adjust the Type 1568 FREQUENCY dial for a peak indication. Adjust the CAL control for a reading of 0 on the DBM scale. Check each position of the MAX INPUT VOLTS switch and METER RANGE switch against the attenuation set by the Type 1450-TB according to Table 6-2. At each position, the meter reading of the Type 1568 should be 0 ±0.3 dB. Repeat the above test at 20 Hz. The meter should indicate 0 ±0.3 dB at all positions. Repeat the test at 20 kHz. The meter should read 0 ±0.4 dB at all positions.

6.4.3 GAIN CHECK.

Use the set-up of Figure 6-2.

Set: Type 1309: FREQUENCY - 1 kHz, OUTPUT - 2.5 V
Type 1450-TB: Attenuation - 22 dB
Type 1568: MAX INPUT VOLTS - 0.1, METER RANGE - 100 mV/-20 (both controls fully cw), FREQUENCY MULTIPLIER - 100 (red).
Tune for a peak at 1 kHz (Range 4). Adjust the CAL control for a full-scale reading.

6.4.4 FREQUENCY CALIBRATION AND PEAK RESPONSE UNIFORMITY.

Assemble the test equipment as shown in Figure 6-3.

Set: Type 1309: FREQUENCY - 1 kHz, OUTPUT - 1 V
Type 1450-TB: Attenuation - 20 dB
Type 1568: FUNCTION - FAST: MAX INPUT VOLTS - 0.1, METER RANGE - 100 mV/-20, FREQUENCY - 1 kHz.

Adjust the Type 1309 Oscillator for a peak meter reading on the Type 1568, then adjust the CAL control for a reading of 0 DBM. The peak frequency as read on the frequency meter must be between 990 and 1010 Hz. Check both FREQUENCY dial accuracy and uniformity of peak amplitude at the frequencies listed in Table 6-3. Record the amplitude at each frequency. The difference between the highest and lowest amplitude readings between 20 Hz and 6.3 kHz must not

## TABLE 6-3
### Frequency and Peak Response Test

| *Frequency Multiplier* | *Frequency Control Setting* | *Limits* | *Record Peak Amplitude* |
|---|---|---|---|
| 10 (white) | 2.0 (20 Hz) | Period: 0.05050 to 0.04950 seconds | |
| | 3.5 (35 Hz) | Period: 0.02886 to 0.2828 seconds | |
| | 6.3 (63 Hz) | Period: 0.01598 to 0.01567 seconds | |
| 10 (red) | 6.4 (64 Hz) | Period: 0.01578 to 0.01547 seconds | |
| | 10.0 (100 Hz) | Period: 0.01010 to 0.009900 seconds | |
| | 20.0 (200 Hz) | Period: 0.005050 to 0.004950 seconds | |
| 100 (white) | 2.00 (200 Hz) | Period: 0.005050 to 0.004950 seconds | |
| | 3.50 (350 Hz) | Period: 0.002886 to 0.002828 seconds | |
| | 6.30 (630 Hz) | Period: 0.001598 to 0.001567 seconds | |
| 100 (red) | 6.40 (640 Hz) | Period: 0.001578 to 0.001547 seconds | |
| | 10.0 (1000 Hz) | Frequency: 990.0 to 1010 Hz | Set reference level |
| | 20.0 (2 kHz) | Frequency: 1980 to 2020 Hz | |
| 1000 (white) | 2.0 (2 kHz) | Frequency: 1980 to 2020 Hz | |
| | 3.5 (2.5 kHz) | Frequency: 3465 to 3535 Hz | |
| | 6.3 (6.3 kHz) | Frequency: 6237 to 6363 Hz | |
| 1000 (red) | 6.4 (6.4 kHz) | Frequency: 6336 to 6464 Hz | |
| | 10.0 (10 kHz) | Frequency: 9900 to 10,100 Hz | |
| | 15.0 (15 kHz) | Frequency: 14, 850 to 15,150 Hz | |
| | 20.0 (20 kHz) | Frequency: 19,800 to 20,200 Hz | |

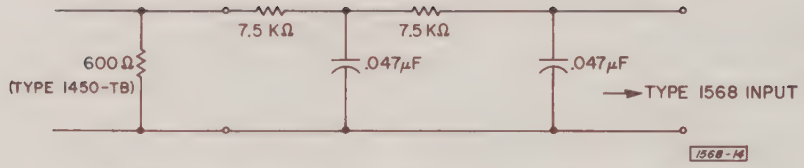



**Figure 6-3. Filter network to attenuate test-oscillator distortion.**

exceed 2 dB. The difference from 20 Hz to 20 kHz must not exceed 4 dB. The frequency must be within ±1% over the entire range.

6.4.5 FILTER ATTENUATION.

Use the same set up used for frequency and amplitude response tests (paragraph 6.4.4).

Set: Type 1309: FREQUENCY - 1 kHz, OUTPUT - 1 V
Type 1450-TB: Attenuation - 0 dB
Type 1568: FUNCTION - FAST, FREQUENCY - 1 kHz, MAX INPUT VOLTS - 1, METER RANGE - 1 V/0.

Adjust the Type 1568 FREQUENCY dial for a peak, then adjust the CAL control for a meter reading of 0 DBM.

Set: FREQUENCY dial - 2 (2 kHz)
METER RANGE - 1 mV/-60

The meter should read greater than 75 dB down from peak amplitude (less than -15 DBM on this range).

Set: FREQUENCY dial -3 (3 kHz)

The Type 1568 meter should read below the 0.5-V line on the upper scale (85 dB below peak).

NOTE

If there is peaking at 2 or 3 kHz, it may be caused by distortion produced by the test oscillator. A filter network (Figure 6-3) will attenuate the output of the oscillator at these frequencies.

6.4.6 OUTPUT AND CREST FACTOR.

Use the set-up described in paragraph 6.4.3.

Set: Type 1309: FREQUENCY - 20 kHz, OUTPUT - 1 V
Type 1450-TB: Attenuation - 21 dB
Type 1568: FUNCTION - FAST, MAX INPUT VOLTS - 0.1, METER RANGE - 100 mV/-20.

Peak the analyzer FREQUENCY at 20 kHz, then adjust the CAL control for a full scale (10) reading on the meter. Connect a 10-kΩ resistor across the OUTPUT jack of the Type 1568 and measure, using the oscilloscope, the voltage across it, which should be between 0.6 and 0.9 V.

Apply the voltage across the 10-kΩ resistor to the vertical input of an oscilloscope. Reduce the attenuation of the Type 1450-TB to 10 dB. There should be no clipping of the output signal. Repeat the above test at a frequency of 20 Hz.

6.4.7 DISTORTION.

NOTE

The power line must be connected for all noise and distortion checks.

Use the set-up of Figure 6-2.

Set: Type 1309: FREQUENCY - 1 kHz, OUTPUT - 1 V
Type 1450-TB: Attenuation - 0 dB
Type 1568: FUNCTION - FAST, MAX INPUT VOLTS - 1, METER RANGE - 1 V/0.

Tune the Type 1568 FREQUENCY for a peak meter reading at 1 kHz, then adjust the CAL control for an indication of +2 DBM.

Set the Type 1568: FREQUENCY - 2 kHz, METER RANGE - 1 mV/-60.

The analyzer meter must indicate less than -13 DBM (equivalent to 75 dB below peak). Vary the FREQUENCY slightly around 2 kHz to see that there is no peaking. See note in paragraph 6.4.5.

6.4.8 NOISE.

Use the set-up of Figure 6-2. Connect a Type 1551 Sound Level Meter to the OUTPUT jack of the Type 1568.

NOTE

The 1568 must be in its cabinet for this check.

Output Noise. This procedure checks the noise level in all sections after the first filter (High Q) section. The first-filter noise is attenuated by 30 dB in the attenuator.

Set: Type 1309: FREQUENCY - 10 kHz, OUTPUT - 1 V
Type 1450-TB: Attenuation - 40 dB
Type 1568: MAX INPUT VOLTS - 0.1, METER RANGE - 10 mV/-40, FREQUENCY MULTIPLIER - 100 (red).
Type 1551: Attenuator - 120 dB, METER-FAST WEIGHTING - 20 kc.

Adjust the Type 1568 FREQUENCY dial for a peak at 10 kHz and the CAL control for a full-scale meter reading. Adjust the Type 1551 CAL control for a full scale reading on its meter. Remove the Type 1309 and short the input of the Type 1568. The 1551 must now indicate less than 65 dB (equivalent to 65 dB below full scale).

Repeat at a frequency of 100 Hz. The Type 1551 must now indicate less than 55 dB (equivalent to 75 dB below full scale).

Front End Noise. This test checks the noise level of all stages, but the noise is predominantly from the first filter (High Q) section. Set the Type 1568 METER RANGE knob to 100 μV/-80 (fully ccw). Check for noise as before using the Type 1309 (for a 100-μV signal into the analyzer) and the Type 1551. At 10

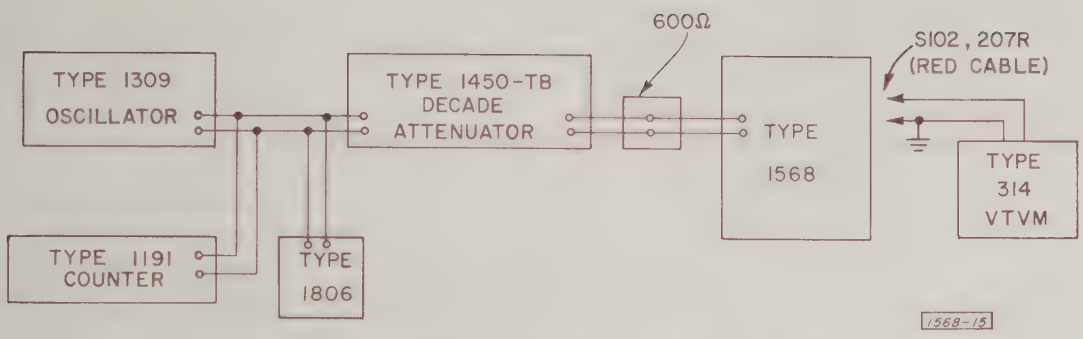



Figure 6-4. Set-up of equipment for alignment of the Type 1568 filter.

kHz the Type 1551 must read less than 100 dB (equivalent to 30 dB below full scale). At 100 Hz the Type 1551 must read less than 85 dB (equivalent to 45 dB below full scale). A graph of typical noise levels vs frequency for various attenuation settings is presented in Section 3.

## 6.5 CALIBRATION PROCEDURE.

### 6.5.1 GENERAL.

Each step in the calibration of the Type 1568 should be performed in sequence since one step serves as a foundation for the next. The Type 1568 incorporates the high reliability one expects of conservatively designed semiconductor circuits and routine calibrations are unnecessary. Calibration will be necessary only if components in the filter section have been replaced.

**CAUTION**

**Always run the instrument through the minimum performance tests of paragraph 6.4 to determine if calibration is required before proceeding. Calibration of the Type 1568 is a rather involved procedure and could lead to difficulty unless carefully performed with the use of proper equipment and testing procedures.**

The various components referred to in the calibration procedure are pointed out in Figure 6-5.

NOTE

The meter of the analyzer must indicate at least in the middle of the BAT region when the FUNCTION switch is set to CK BAT. If it does not, charge the battery for several hours before proceeding with the calibration.

### 6.5.2 EQUIPMENT REQUIRED.

The equipment required to calibrate the Wave Analyzer is the same as that required to test the minimum performance specifications (refer to paragraph 6.4), with three exceptions:

1. An oscilloscope is not required.
2. A sound level meter is not required.
3. For calibration, a VTVM having an input impedance of at least 10 MΩ and sensitivity of 1 mV is required. The Ballantine Model 314 is recommended.

### 6.5.3 FILTER ALIGNMENT, HIGH Q SECTION.

Assemble the test equipment as shown in Figure 6-4. The Model 314 Voltmeter is connected between terminal 207R of S102 and ground (see Figure 6-5 and paragraph 6.3.

Set: Type 1309: FREQUENCY-640 Hz, OUTPUT-1 V.
Type 1450-TB: Attenuation - 40 dB.
Type 1568: FREQUENCY MULTIPLIER - 100 (red), MAX INPUT VOLTS - 0.1, METER RANGE - 10 mV/-40, CAL control-centered, FUNCTION - FAST.

a. Tune the analyzer FREQUENCY control for a peak reading on the Model 314 meter. If necessary, loosen the setscrews on the FREQUENCY dial, adjust it to read 640 Hz, then retighten the screws.

b. Adjust the Type 1450-TB Attenuator so that the Model 314 indicates a convenient value when the FREQUENCY dial is set for the peak. Record this value for future reference.

c. Set:
Type 1309: FREQUENCY - 2 kHz, OUTPUT - 1 V
Type 1568: FREQUENCY MULTIPLIER - 100 (red), FREQUENCY control - 20.0.

Adjust the oscillator frequency to obtain a peak reading on the Model 314. Adjust R126 and R140 to obtain a peak frequency at 2 kHz and at the same time a peak voltmeter reading of the same amplitude as in b. (R140 changes both amplitude and frequency in the same direction; R126 changes them in opposite directions.)

d. Repeat steps a, b, and c if necessary.

e. Set:
Type 1568: FREQUENCY MULTIPLIER - 100 (red), FREQUENCY control - 11.0 (1.1 kHz)
Type 1309: FREQUENCY - 110 Hz, OUTPUT - 1 V

Adjust the Type 1450-TB Attenuator for a reading of 0.003 V on the Model 314. Set the FREQUENCY of the Type 1309 to 1.1 kHz, adjusting slightly to obtain a peak reading on the Model 314. Adjust R137 for a reading of 0.24 V on the Model 314.

f. Adjust all other ranges, tuning for a peak at the frequency indicated in Table 6-4 and adjusting the respective potentiometer for a reading of 0.24 V on the Model 314. On the last range (red 1000), adjust trimmer C119 first to get a peak reading at 6.4 kHz, then adjust R139 to obtain a reading of 0.24 V at 11 kHz.

**TABLE 6-4**
**Filter Alignment, High Q Section**

| *Frequency Multiplier* | *Frequency Control* | *Adjust* |
|---|---|---|
| 1000 (red) | 11.0 (6.4 kHz) | C119 |
| 1000 (red) | 11.0 (11 kHz) | R139 |
| 10 (red) | 11.0 (110 Hz) | R135 |
| 10 (white) | 3.5 (35 Hz) | R134 |
| 100 (white) | 3.5 (350 Hz) | R136 |
| 1000 (white) | 3.5 (3.5 kHz) | R138 |

6.5.4 FILTER ALIGNMENT, LOW Q SECTION.

Use the setup of Figure 6-4 except disconnect the Model 314 and unsolder the red cable from S102, 207R. Remove the input (supplied by the Type 1309) from the front panel jack and connect it to S102, 207R.

Set: Type 1309: FREQUENCY - 200 Hz, OUTPUT - 1 V.
Type 1450-TB: Attenuation - 10 dB.
Type 1568: FREQUENCY MULTIPLIER - 100 (white)

a. Adjust the Type 1568 FREQUENCY control for a peak reading on the Type 1568 meter (around 2 on the dial).

b. Adjust the Type 1450-TB so that the analyzer meter indicates a convenient value when the FREQUENCY control is set for the peak. Record this value for future reference.

c. Set the Type 1568 FREQUENCY control to 6.3, FREQUENCY MULTIPLIER to 100 (white), and adjust the Type 1309 FREQUENCY for a peak reading on the meter of the Type 1568.

d. Adjust R163 and R172 to obtain a peak frequency at 630 Hz and a peak meter reading of the same amplitude as that recorded in b. (R163 changes both amplitude and frequency in the same direction; R172 changes them in opposite directions.)

e. Repeat steps a, b, c, and d if necessary.

f. Set:
Type 1309: FREQUENCY - 3.5 Hz, OUTPUT - 1 V
Type 1568: FREQUENCY control - 3.5, FREQUENCY MULTIPLIER - 100 (white), MAX INPUT VOLTS - 0.1, METER RANGE - 300 μV/-70.
Adjust the Type 1450-TB for a reading of 200 μV on the analyzer meter.

g. Set:
Type 1568: METER RANGE - 10 mV/-40.
Type 1309: FREQUENCY - 350 Hz.
Adjust R180 for an analyzer meter reading of 8 mV.

h. Adjust all other ranges, tuning for a peak at the frequency indicated in Table 6-5 and adjusting the respective potentiometer for a reading of 8 mV on the Type 1568 meter. On the last range (red 1000), first adjust C130 to get a peak reading at 6.4 kHz, then adjust R183 to get a reading at 11 kHz.

**TABLE 6-5**
**Filter Alignment, Low Q Section**

| *Frequency Multiplier* | *Frequency Control* | *Adjust* |
|---|---|---|
| 10 (white) | 3.5 (35 Hz | R178 |
| 1000 (white | 3.5 (3.5 kHz) | R182 |
| 1000 (red) | 11.0 (6.4 kHz) | R130 |
| 1000 (red) | 11.0 (11 kHz) | R183 |
| 100 (red) | 11.0 (1.1 kHz) | R181 |
| 10 (red) | 11.0 (110 Hz) | R179 |

i. Resolder the red cable to S102, 207R.

6.5.5 SWITCH PHASING.

Blanking Switch. Adjust the blanking switch wiper part number 1568-1221 (see Figure 6-5), so that it blanks the output signal starting at a point about 1/8 in past the "20" point on the FREQUENCY dial. Note that the signal remains shorted throughout the entire blank area of the FREQUENCY dial, and that it opens again at least 1/8 in before it gets to the "6.3" point on the dial.

NOTE

The wiper arms should have adequate pressure on the track, and they should be bent so that they are parallel to the track surface.

Multiplier Switching. Adjust the hub assembly, part number 1568-1120, on the rear of the right-hand potentiometer (see Figure 6-5) so that the microswitch is activated about a third of the way through the blank area of the FREQUENCY dial (in the direction of increasing frequency).

Connect the Type 1568 to the power line and set the MULTIPLIER SWITCHING switch to AUTO. Note that the FREQUENCY MULTIPLIER switch changes range each time the FREQUENCY dial is swept through the blank region.

It should take less than 5 s for the capacitor C501 to recharge so that it will switch the motor a second time. A longer recharge time may indicate a faulty rectifier circuit or capacitor.

Set the MULTIPLIER SWITCHING switch to MANUAL. The FREQUENCY MULTIPLIER switch should not change ranges when the FREQUENCY dial is swept through the blank area.

6.5.6 PEAK RESPONSE ADJUSTMENT.

Perform the frequency and response uniformity test of paragraph 6.4.3, if you have not done so already.

## TABLE 6-6
### Dc Voltages

#### HIGH Q SECTION

| *Measurement to ground from:* | | *dc volts* |
|---|---|---|
| Q101 | E | 9.5 |
| | C | 13.7 |
| Q102 | E | 14.2 |
| | C | 9.5 |
| Q103 | E | 15.0 |
| | C | 9.5 |
| Q104 | E | 9.0 |
| | C | 13.7 |
| Q105 | E | 14.3 |
| | C | 9.8 |
| Q106 | E | 15.0 |
| | C | 9.8 |
| Q107 | E | 9.4 |
| | C | 13.7 |
| Q108 | E | 14.3 |
| | C | 9.4 |
| Q109 | E | 15.0 |
| | C | 9.4 |
| Q110 | E | 1.00 |
| | C | 9.4 |
| Q111 | E | 14.4 |
| | C | 15.5 |
| Q112 | E | 15.0 |
| | C | 21.0 |

#### OUTPUT AMPLIFIER

| | | |
|---|---|---|
| Q201 | E | 1.85 |
| | C | 11.9 |
| Q202 | E | 1.30 |
| | C | 4.50 |
| Q203 | E | 3.90 |
| | C | 9.3 |
| Q204 | E | 2.80 |
| | C | 12.0 |

#### LOW Q SECTION

| *Measurement to ground from:* | | *dc volts* |
|---|---|---|
| Q113 | E | 15.0 |
| | C | 16.0 |
| Q114 | E | 15.5 |
| | C | 21.0 |
| Q115 | E | 9.8 |
| | C | 14.2 |
| Q116 | E | 14.9 |
| | C | 9.8 |
| Q117 | E | 15.5 |
| | C | 9.8 |
| Q118 | E | 8.8 |
| | C | 14.2 |
| Q119 | E | 14.9 |
| | C | 8.8 |
| Q120 | E | 15.5 |
| | C | 8.8 |
| Q121 | E | 1.10 |
| | C | 8.8 |
| Q122 | E | 8.6 |
| | C | 14.2 |
| Q123 | E | 14.9 |
| | C | 9.3 |
| Q124 | E | 15.5 |
| | C | 9.3 |

#### POWER SUPPLY SECTION

| | |
|---|---|
| AT508 | 60.0 |
| C502+ | 48.0 |
| AT512 | 21.0 |

Note: Letter E refers to transistor emitter; C refers to collector.

The difference between the highest and lowest amplitudes in the 20-Hz to 20-kHz range must not exceed 4 dB. Furthermore, the highest and lowest points must both occur in the highest frequency range (FREQUENCY MULTIPLIER set to red 1000). If this is not the case, adjust R183 to center this range on the other ranges, that is, make the maximum amplitude of the highest range greater than the maximum of any other range, and the minimum lower than any other minimum amplitude.

6.5.7 CAL CIRCUIT ADJUSTMENT.

Set: Type 1309: FREQUENCY - 1 kHz, OUTPUT - 1 V (exactly).

Type 1450-TB: Attenuation -40 dB.

Type 1568: FUNCTION - FAST: MAX INPUT VOLTS - 0.1, METER RANGE - 10 V/-40(both white dots on attenuator controls at 12 o'clock).

Adjust the FREQUENCY controls of the Type 1568 for a peak at 1 kHz (range - red 100). Adjust the CAL control for a full-scale (10) reading. Set the FUNCTION switch to CAL, and adjust R222 (on the power supply board) until the meter reads in the middle of the CAL area.

Set: Type 1568: FUNCTION - CAL, FREQUENCY MULTIPLIER - 100 (red), FREQUENCY control - 20.0.

Adjust the CAL control to read in the middle of the CAL area on the meter. Set the FUNCTION switch to FAST. Adjust the Type 1309 FREQUENCY for a peak at 20 kHz. The Type 1568 meter must read between 9.6 and 10.4.

## 6.6 TROUBLE ANALYSIS.

6.6.1 GENERAL.

The Type 1568 Wave Analyzer needs no routine maintenance. If difficulties arise, the following information is provided to aid in localizing the trouble. Refer to Section 5 and Figures 6-6 and following for information concerning the operation of the analyzer.

6.6.2 VISUAL CHECK.

If the analyzer does not function properly when operated according to the instructions in Section 3, perform the following checks to locate any immediately obvious failures:

a. Look for any sign of damaged components, such as broken resistors, burned capacitors, and the like.

b. Look for any loose conductors, e.g., screws, bits of solder, that may have fallen into the instrument.

c. Look for broken cables. Sometimes a broken wire is held in place by its insulation, so that it is necessary to apply a slight pulling pressure to the wire to find a break. Perform this test on the cables leading to anchor terminals and switches.

6.6.3 BIAS CONDITIONS.

Table 6-6 lists the dc voltage levels to be expected at the emitter and collector of each transistor in the Type 1568. These voltages were measured with a VTVM and are typical values. Individual instruments should agree within ±10% of the values given when measured under the following conditions.

Line voltage . . . . . 115 V ac (or 230 V ac)
FUNCTION . . . . . FAST
BATTERY . . . . . Fully charged (9.6 V)
All other controls . . Any position

Refer to Figures 6-6 through 6-14 as well as 6-1, for location of various test points.

6.6.4 AC VOLTAGE LEVELS.

To check the active operation of the various sections of the analyzer proceed as follows:

a. Apply a 1-V, rms, 1-kHz signal from the Type 1309 to the INPUT of the analyzer via the Type 1650-P95 Patch Cord.

b. Set:
MAX INPUT VOLTS - 1
METER RANGE - 1 V (0 dB)
FUNCTION - FAST
FREQUENCY MULTIPLIER - 100 (red
FREQUENCY dial - Around 10 (Tune for a peak indication on meter or, if non-functioning, a peak on the CRO at the first test point.)
CAL control - Center (white dot up)

c. Observe the waveform at the points listed in Table 6-7 on an oscilloscope which has an input sensitivity of at least 10 mV/div. The peak-to-peak voltages should agree with those in Table 6-7 to within ±20%. There should be no trace of distortion except where noted. Refer to Figures 6-6 through 6-14, as well as Figure 6-1, for locations of the test points.

**TABLE 6-7**
**Typical Ac Voltage Levels**

| *Observe between ground and:* | *Peak-to-Peak Voltage* |
|---|---|
| SO106, Term #3 | 2.6 V |
| Q101, Base | 0.02 V |
| Q109, Coll. | 1.3 V |
| Q115, Base | 0.04 V |
| Q124, Coll. | 1.3 V |
| Q201, Coll. | 2.4 V (Visible distortion) |
| Q202, Base | 0.4 V |
| Q202, Em. | 0.4 V |
| Q204, Coll. | 3.0 V |

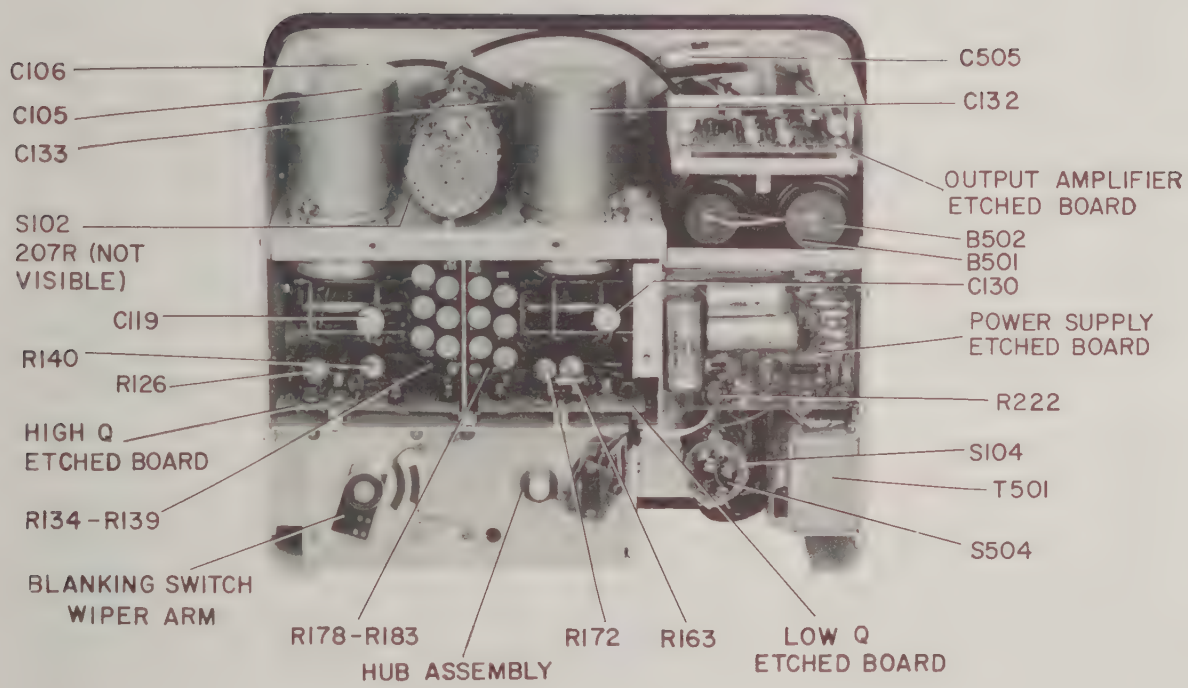



Figure 6-5. Access to components: interior view of the Type 1568.

# PARTS LIST

| Ref. No. | Description | Part No. | Fed. Mfg. Code | Mfg. Part No. | Fed. Stock Number |
|---|---|---|---|---|---|
| **CAPACITORS** | | | | | |
| C101 | Plastic, 0.47 µF ±10% 400 V | 4860-9725 | 84411 | 663F, 0.47 µF ±10% | |
| C102 | Electrolytic, 5 µF +100-10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C103 | Ceramic, 0.001 µF ±5% 500 V | 4405-2105 | 72982 | 801, 0.001 µF ±5% | |
| C104 | Electrolytic, 5 µF +100-10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C105 | Plastic (special), 2.57 µF ±0.25% 150 V | 4860-4901 | 84411 | 663UW, 2.57 µF ±0.25% | |
| C106 | Plastic (special), 0.813 µF ±0.25% 150 V | 4872-4812 | 24655 | 4872-4812 | |
| C107 | Plastic, 0.257 µF ±0.25% 100 V | 4869-3257 | 24655 | 4869-3257 | |
| C108 | Plastic, 0.0813 µF ±0.25% 100 V | 4868-2813 | 24655 | 4868-2813 | |
| C109 | Plastic, 0.0257 µF ±0.25% 100 V | 4868-2257 | 24655 | 4868-2257 | |
| C110 | Plastic, 0.00813 µF ±0.25% 25 V | 4868-1257 | 24655 | 4868-1257 | |
| C111 | Ceramic, 470 pF ±10% 500 V | 4404-2105 | 72982 | 831,470 pF ±10% | |
| C112 | Ceramic, 470 pF ±10% 500 V | 4404-2105 | 72982 | 831, 470 pF ±10% | |
| C113 | Plastic, 0.257 µF ±0.25% 100 V | 4869-3257 | 24655 | 4869-3257 | |
| C114 | Plastic, 0.0813 µF ±0.25% 100 V | 4868-2813 | 24655 | 4868-2813 | |
| C115 | Plastic, 0.0257 µF ±0.25% 100 V | 4868-2257 | 24655 | 4868-2257 | |
| C116 | Plastic, 0.00813 µF ±0.25% 25 V | 4868-1813 | 24655 | 4868-1813 | |
| C117 | Plastic, 0.00255 µF ±0.25% 25 V | 4868-1255 | 24655 | 4868-1255 | |
| C118 | Plastic, 775 pF ±0.5% 25 V | 4868-0775 | 24655 | 4868-0775 | |
| C119 | Trimmer, 5 pF to 25 pF | 4910-1150 | 72982 | 557-051, U2P0 | |
| **DIODES** | | | | | |
| CR107 | Zener, 15-V, ±5% Type 1N965B, selected for low noise | 6083-1047 | 07910 | 1N965B | 5961-877-6192 |
| CR205 | Rectifier, Type 1N645 | 6082-1016 | 24446 | 1N645 | 5961-944-8222 |
| CR206 | Rectifier, Type 1N645 | 6082-1016 | 24446 | 1N645 | 5961-944-8222 |
| **TRANSISTORS** | | | | | |
| Q101 | Type 2N3390 | 8210-1077 | 24454 | 2N3390 | |
| Q102 | Type 2N1131 | 8210-1025 | 96214 | 2N1131 | 5961-081-8365 |
| Q103 | Type 2N1131 | 8210-1025 | 96214 | 2N1131 | 5961-081-8365 |
| Q104 | Type 2N3390 | 8210-1077 | 24454 | 2N3390 | |
| Q105 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q106 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q107 | Type 2N3390 | 8210-1077 | 24454 | 2N3390 | |
| Q108 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q109 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q110 thru Q112 | Type 2N3416 | 8210-1047 | 24446 | 2N3416 | 5961-989-2749 |
| **RESISTORS** | | | | | |
| R101 | Film, 31.6 Ω ±1% 1/8 W | 6250-9316 | 75042 | CEA, 31.6 Ω ±1% | 5905-721-0292 |
| R102 | Film, 67.3 Ω ±1% 1/8 W | 6250-9673 | 75042 | CEA, 67.3 Ω ±1% | |
| R103 | Film, 213 Ω ±1% 1/8 W | 6250-0213 | 75042 | CEA, 213 Ω ±1% | |
| R104 | Film, 698 Ω ±1/8 W | 6250-0698 | 75042 | CEA, 698 Ω ±1% | 5905-824-8535 |
| R105 | Film, 2.29 kΩ ±1% 1/8 W | 6250-1229 | 75042 | CEA, 2.29 kΩ ±1% | |
| R106 | Film, 7.68 kΩ ±1% 1/8 W | 6250-1768 | 75042 | CEA, 7.68 kΩ ±1% | 5905-978-8817 |
| R107 | Film, 35.2 kΩ ±1% 1/2 W | 6450-2352 | 75042 | CEC, 35.2 kΩ ±1% | |
| R108 | Film, 54.2 kΩ ±1% 1/2 W | 6450-2542 | 75042 | CEC, 54.2 kΩ ±1% | |
| R109 | Film, 14 kΩ ±1% 1/8 W | 6250-2140 | 75042 | CEA, 14 kΩ ±1% | |
| R110 | Composition, 11 kΩ ±5% 1/2 W | 6100-3115 | 01121 | RC20GF113J | 5905-279-2667 |
| R111 | Potentiometer, composition 250 kΩ ±10% CAL | 6045-1061 | 01121 | JT, 250 kΩ ±10% | |
| R112 | Film, 124 kΩ ±1% 1/4 W | 6350-3124 | 75042 | CEB, 124 kΩ ±1% | 5905-722-0915 |
| R113 | Film, 249 kΩ ±1% 1/8 W | 6250-3249 | 75042 | CEA, 249 kΩ ±1% | 5905-702-9574 |
| R114 | Film, 11.1 kΩ ±1% 1/8 W | 6250-2111 | 75042 | CEA, 11.1 kΩ ±1% | |
| R115 | Film, 46.4 kΩ ±1% 1/8 W | 6250-2464 | 75042 | CEA, 46.4 kΩ ±1% | 5905-702-1771 |
| R116 | Film, 89.8 kΩ ±1% 1/4 W | 6350-2898 | 75042 | CEB, 89.8 kΩ ±1% | |
| R117 | Film, 68.1 kΩ ±1% 1/4 W | 6350-2681 | 75042 | CEB, 68.1 kΩ ±1% | 5905-581-7564 |
| R118 | Composition, 360 kΩ ±5% 1/4 W | 6099-4365 | 75042 | BTS, 360 kΩ ±5% | |
| R119 | Composition, 180 kΩ ±5% 1/4 W | 6099-4185 | 75042 | BTS, 180 kΩ ±5% | |
| R120 | Composition, 4.7 kΩ ±5% 1/4 W | 6099-2475 | 75042 | BTS, 4.7 kΩ ±5% | 5905-686-9998 |
| R121 | Composition, 56 kΩ ±5% 1/4 W | 6099-3565 | 75042 | BTS, 56 kΩ ±5% | 5905-800-0179 |
| R122 | Composition, 20 kΩ ±5% 1/2 W | 6100-3205 | 01121 | RC20GF203J | 5905-192-0649 |
| R123 | Composition, 3.9 kΩ ±5% 1/4 W | 6099-2395 | 75042 | BTS, 3.9 kΩ ±5% | |
| R124 | Composition, 5.1 kΩ ±5% 1/4 W | 6099-2515 | 75042 | BTS, 5.1 kΩ ±5% | |
| R125 | Composition, 4.3 kΩ ±5% 1/4 W | 6099-2435 | 75042 | BTS, 4.3 kΩ ±5% | |
| R126 | Potentiometer, wire-wound, 200 Ω ±5% | 6053-1205 | 75042 | CT-106, 200 Ω ±5% | |
| R127 | Precision, (special) 2.87 kΩ ±0.25% | 6690-6254 | 24655 | 6690-6254 | |

## PARTS LIST (cont)

| Ref No. | Description | Part No. | Fed. Mfg. Code | Mfg. Part No. | Fed. Stock Number |
|---|---|---|---|---|---|
| **RESISTORS (cont)** | | | | | |
| R128A | Potentiometer, wire-wound* | | | | |
| R128B | 7.2 kΩ | | | | |
| R128C | Potentiometer, wire-wound* | 0975-4310 | 24655 | 0975-4310 | |
| R128D | 7.2 kΩ | | | | |
| R129 | Precision, (special) 5.11 kΩ ±0.25% | 6690-6286 | 24655 | 6690-6286 | |
| R130 | Precision, (special) 464 Ω ±0.25% | 6690-6226 | 24655 | 6690-6226 | |
| R131 | Composition, 56 kΩ ±5% | 6099-3565 | 75042 | BTS, 56 kΩ ±5% | 5905-800-0179 |
| R132 | Composition, 100 Ω ±5% | 6099-1105 | 75042 | BTS, 100 Ω ±5% | |
| R133 | Composition, 3.9 kΩ ±5% | 6099-2395 | 75042 | BTS, 3.9 kΩ ±5% | |
| R134 thru R139 | Potentiometer, wire-wound 50 Ω ±5% | 6058-0505 | 75042 | CT-100, 50 Ω ±5% | |
| R140 | Potentiometer, wire-wound 200 Ω ±5% | 6053-1205 | 75042 | CT-106-2, 200 Ω ±5% | |
| R141 | Precision, (special) 2.87 kΩ ±0.25% | 6690-6254 | 24655 | 6690-6254 | |
| R142 | Composition, 56 kΩ ±5% 1/4 W | 6099-3565 | 75042 | BTS, 56 kΩ ±5% | 5905-800-0179 |
| R143 | Composition, 100 Ω ±5% 1/4 W | 6099-1105 | 75042 | BTS, 100 Ω ±5% | |
| R144 | Composition, 3.9 kΩ ±5% 1/4 W | 6099-2395 | 75042 | BTS, 3.9 kΩ ±5% | |
| R145 | Composition, 1 kΩ ±5% 1/4 W | 6099-2105 | 75042 | BTS, 1 kΩ ±5% | 5905-681-6462 |
| R146 | Composition, 510 Ω ±5% 1/4 W | 6099-1515 | 75042 | BTS, 510 Ω ±5% | 5905-801-8272 |
| R147 | Composition, 5.1 kΩ ±5% 1/4 W | 6099-2515 | 75042 | BTS, 5.1 kΩ ±5% | 5905-279-4623 |
| R148 | Composition, 39 kΩ ±5% 1/4 W | 6099-3395 | 75042 | BTS, 39 kΩ ±5% | 5905-686-3358 |
| R149 | Composition, 200 kΩ ±5% 1/4 W | 6099-4205 | 75042 | BTS, 200 kΩ ±5% | 5905-681-8821 |
| R150 | Film, 9.09 kΩ ±1% 1/8 W | 6250-1909 | 75042 | CEA, 9.09 kΩ ±1% | 5905-655-3167 |
| R151 | Film, 68.1 kΩ ±1% 1/4 W | 6350-2681 | 75042 | CEB, 68.1 kΩ ±1% | 5905-581-7564 |
| R152 | Film, 33.2 kΩ ±1% 1/8 W | 6250-2332 | 75042 | CEA, 33.2 kΩ ±1% | 5905-681-8758 |
| R153 | Film, 3.74 kΩ ±1% 1/8 W | 6250-1374 | 75042 | CEA, 3.74 kΩ ±1% | |
| R154 | Composition, 300 kΩ ±5% 1/4 W | 6099-4305 | 75042 | BTS, 300 kΩ ±5% | 5905-681-8854 |
| R155 | Composition, 150 kΩ ±5% 1/4 W | 6099-4155 | 75042 | BTS, 150 kΩ ±5% | 5905-686-9995 |
| R156 | Composition, 56 kΩ ±5% 1/4 W | 6099-3565 | 75042 | BTS, 56 kΩ ±5% | 5905-800-0179 |
| R158 | Composition, 3.9 kΩ ±5% 1/4 W | 6099-2395 | 75042 | BTS, 3.9 kΩ ±5% | |
| R159 | Composition, 4.7 kΩ ±5% 1/4 W | 6099-2475 | 75042 | BTS, 4.7 kΩ ±5% | 5905-686-9998 |
| **SWITCHES** | | | | | |
| S101 | Rotary, 8-position MAX INPUT, METER RANGE | 7890-4020 | 24655 | 7890-4020 | |
| S102 | Rotary, 7-position METER RANGE part of S101 | 7890-4020 | 24655 | 7890-4020 | |
| S103 | Rotary, 6-position FREQUENCY MULTIPLIER | 7890-4030 | 24655 | 7890-4030 | |
| S104 | Rotary, 6-position FUNCTION | 7890-4040 | 24655 | 7890-4040 | |
| S105 | Switch Board Assembly | 1564-1710 | 24655 | 1564-1710 | |
| **SOCKETS** | | | | | |
| SO101 | 8-Connector, | 4230-2708 | 95354 | CD608SF | |
| SO102 | 6-Connector, | 4230-2706 | 95354 | CD606SF | |
| SO106 | 3-Connector, female INPUT | 4230-2696 | 71468 | XLR-3-1 | |
| **MISCELLANEOUS** | | | | | |
| J101 | JACK, Telephone INPUT | 4260-1500 | 82389 | 2J-1503 | 5935-636-5923 |

## FEDERAL MANUFACTURERS CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through June, 1967.

| Code | Manufacturers Name and Address |
|---|---|
| 00192 | Jones Mfg. Co., Chicago, Illinois |
| 00194 | Walsco Electronics Corp., Los Angeles, Calif. |
| 00656 | Aerovox Corp., New Bedford, Mass. |
| 01009 | Alden Products Co., Brockton, Mass. |
| 01121 | Allen-Bradley, Co., Milwaukee, Wisc. |
| 01295 | Texas Instruments, Inc., Dallas, Texas |
| 02114 | Ferroxcube Corp. of America, Saugerties, N. Y. 12477 |
| 02606 | Fenwal Lab. Inc., Morton Grove, Ill. |
| 02660 | Amphenol Electronics Corp., Broadview, Ill. |
| 02768 | Fastex Division of Ill. Tool Works, Des Plaines, Ill. 60016 |
| 03508 | G. E. Semiconductor Products Dept., Syracuse, N. Y. 13201 |
| 03636 | Grayburne, Yonkers, N. Y. 10701 |
| 03888 | Pyrofilm Resistor Co., Cedar Knolls, N. J. |
| 03911 | Clairex Corp., New York, N. Y. 10001 |
| 04009 | Arrow, Hart and Hegeman Electric Co., Hartford, Conn. 06106 |
| 04713 | Motorola Semi-Conduct Product, Phoenix, Ariz. 85008 |
| 05170 | Engineered Electronics Co., Inc., Santa Ana, Calif. 92702 |
| 05624 | Barber-Colman Co., Rockford, Ill. 61101 |
| 05820 | Wakefield Eng., Inc., Wakefield, Mass. 01880 |
| 07127 | Eagle Signal Div. of E. W. Bliss Co., Baraboo, Wisc. |
| 07261 | Avnet Corp., Culver City, Calif. 90230 |
| 07263 | Fairchild Camera and Instrument Corp., Mountain View, Calif. |
| 07387 | Birtcher Corp., No. Los Angeles, Calif. |
| 07595 | American Semiconductor Corp., Arlington Heights, Ill. 60004 |
| 07828 | Bodine Corp., Bridgeport, Conn. 06605 |
| 07829 | Bodine Electric Co., Chicago, Ill. 60618 |
| 07910 | Continental Device Corp., Hawthorne, Calif. |
| 07983 | State Labs Inc., N. Y., N. Y. 10003 |
| 07999 | Amphenol Corp., Borg Inst. Div., Delavan, Wisc. 53115 |
| 08730 | Vemaline Prod. Co., Franklin Lakes, N. J. |
| 09213 | General Electric Semiconductor, Buffalo, N. Y. |
| 09408 | Star-Tronics Inc., Georgetown, Mass. 01830 |
| 09823 | Burgess Battery Co., Freeport, Ill. |
| 09922 | Burndy Corp., Norwalk, Conn. 06852 |
| 11236 | C.P.S. of Berne, Inc., Berne, Ind. 46711 |
| 11599 | Chandler Evans Corp., W. Hartford, Conn. |
| 12498 | Teledyn Inc., Crystalonics Div., Cambridge, Mass. 02140 |
| 12672 | RCA Commercial Receiving Tube and Semi-conductor Div., Woodridge, N.J. |
| 12697 | Clarostat Mfg. Co. Inc., Dover, N. H. 03820 |
| 12954 | Dickson Electronics Corp., Scottsdale, Ariz. |
| 13327 | Solitron Devices, Tappan, N. Y. 10983 |
| 14433 | ITT Semiconductors, W. Palm Beach, Florida |
| 14655 | Cornell Dubilier Electric Co., Newark N. J. |
| 14674 | Corning Glass Works, Corning, N. Y. |
| 14936 | General Instrument Corp., Hicksville, N. Y. |
| 15238 | ITT, Semiconductor Div. of Int. T. and T, Lawrence, Mass. |
| 15605 | Cutler-Hammer Inc., Milwaukee, Wisc. 53233 |
| 16037 | Spruce Pine Mica Co., Spruce Pine, N. C. |
| 19644 | LRC Electronics, Horseheads, New York |
| 19701 | Electra Mfg. Co., Independence, Kansas 67301 |
| 21335 | Fafnir Bearing Co., New Briton, Conn. |
| 24446 | G. E. Schenectady, N. Y. 12305 |
| 24454 | G. E., Electronic Comp., Syracuse, N. Y. |
| 24455 | G. E. (Lamp Div), Nela Park, Cleveland, Ohio |
| 24655 | General Radio Co., W. Concord, Mass 01781 |
| 26806 | American Zettler Inc., Costa Mesa, Calif. |
| 28520 | Hayman Mfg. Co., Kenilworth, N. J. |
| 28959 | Hoffman Electronics Corp., El Monte, Calif. |
| 30874 | International Business Machines, Armonk, N.Y. |
| 32001 | Jensen Mfg. Co., Chicago, Ill. 60638 |
| 35929 | Constanta Co. of Canada Limited, Montreal 19, Quebec |
| 37942 | P. R. Mallory and Co. Inc., Indianapolis, Ind. |
| 38443 | Marlin-Rockwell Corp., Jamestown, N. Y. |
| 40931 | Honeywell Inc., Minneapolis, Minn. 55408 |
| 42190 | Muter Co., Chicago, Ill. 60638 |
| 42498 | National Co. Inc., Melrose, Mass. 02176 |
| 43991 | Norma-Hoffman Bearings Corp., Stanford, Conn. 06904 |
| 49671 | RCA, New York, N. Y. |
| 49956 | Raytheon Mfg. Co., Waltham, Mass. 02154 |
| 53021 | Sangamo Electric Co., Springfield, Ill. 62705 |
| 54294 | Shallcross Mfg. Co., Selma, N. C. |
| 54715 | Shure Brothers, Inc., Evanston, Ill. |
| 56289 | Sprague Electric Co., N. Adams, Mass. |
| 59730 | Thomas and Betts Co., Elizabeth, N. J. 07207 |
| 59875 | TRW Inc. (Accessories Div), Cleveland, Ohio |
| 60399 | Torrington Mfg. Co., Torrington, Conn. |
| 61637 | Union Carbide Corp., New York, N. Y. 10017 |
| 61864 | United-Carr Fastener Corp., Boston, Mass. |
| 63060 | Victoreen Instrument Co., Inc., Cleveland, Ohio |
| 63743 | Ward Leonard Electric Co., Mt. Vernon, N. Y |
| 65083 | Westinghouse (Lamp Div), Bloomfield, N. J. |
| 65092 | Weston Instruments, Weston-Newark, Newark, N. J. |
| 70485 | Atlantic-India Rubber Works, Inc., Chicago, Ill. 60607 |
| 70563 | Amperite Co., Union City, N. J. 07087 |
| 70903 | Belden Mfg. Co., Chicago, Ill. 60644 |
| 71126 | Bronson, Homer D., Co., Beacon Falls, Conn. |
| 71294 | Canfield, H. O. Co., Clifton Forge, Va. 24422 |
| 71400 | Bussman Mfg. Div. of McGraw Edison Co., St. Louis, Mo. |
| 71590 | Centralab, Inc., Milwaukee, Wisc. 53212 |
| 71666 | Continental Carbon Co., Inc., New York, N. Y. |
| 71707 | Coto Coil Co. Inc., Providence, R. I. |
| 71744 | Chicago Miniature Lamp Works, Chicago, Ill. |
| 71785 | Cinch Mfg. Co. and Howard B. Jones Div., Chicago, Ill. 60624 |
| 71823 | Darnell Corp., Ltd., Downey, Calif. 90241 |
| 72136 | Electro Motive Mfg. Co., Willmington, Conn. |
| 72259 | Nytronics Inc., Berkeley Heights, N. J. 07922 |
| 72619 | Dialight Co., Brooklyn, N. Y. 11237 |
| 72699 | General Instrument Corp., Capacitor Div., Newark, N. J. 07104 |
| 72765 | Drake Mfg. Co., Chicago, Ill. 60656 |
| 72825 | Hugh H. Eby, Inc., Philadelphia, Penn. 19144 |
| 72962 | Elastic Stop Nut Corp., Union, N. J. 07083 |
| 72982 | Erie Technological Products Inc., Erie, Penn. |
| 73138 | Beckman, Inc., Fullerton, Calif. 92634 |
| 73445 | Amperex Electronics Co., Hicksville, N. Y. |
| 73559 | Carling Electric Co., W. Hartford, Conn. |
| 73690 | Elco Resistor Co., New York, N. Y. |
| 73899 | J. F. D. Electronics Corp., Brooklyn, N. Y. |
| 74193 | Heinemann Electric Co., Trenton, N. J. |
| 74861 | Industrial Condenser Corp., Chicago, Ill. |
| 74970 | E. F. Johnson Co., Waseca, Minn. 56093 |
| 75042 | IRC Inc., Philadelphia, Penn. 19108 |
| 75382 | Kulka Electric Corp., Mt. Vernon, N. Y. |
| 75491 | Lafayette Industrial Electronics, Jamaica, N.Y. |
| 75608 | Linden and Co., Providence, R. I. |
| 75915 | Littelfuse, Inc., Des Plaines, Ill. 60016 |
| 76005 | Lord Mfg. Co., Erie, Penn. 16512 |
| 76149 | Malloy Electric Corp., Detroit, Mich. 48204 |
| 76487 | James Millen Mfg. Co., Malden, Mass. 02148 |
| 76545 | Mueller Electric Co., Cleveland, Ohio 44114 |
| 76684 | National Tube Co., Pittsburg, Penn. |
| 76854 | Oak Mfg. Co., Crystal Lake, Ill. |
| 77147 | Patton MacGuyer Co., Providence, R. I. |
| 77166 | Pass-Seymour, Syracuse, N. Y. |
| 77263 | Pierce Roberts Rubber Co., Trenton, N. J. |
| 77339 | Positive Lockwasher Co., Newark , N. J. |
| 77542 | Ray-O-Vac Co., Madison, Wisc. |
| 77630 | TRW, Electronic Component Div., Camden, N. J. 08103 |
| 77638 | General Instruments Corp., Brooklyn, N. Y. |
| 78189 | Shakeproof Div. of Ill. Tool Works, Elgin, Ill. 60120 |
| 78277 | Sigma Instruments Inc., S. Braintree, Mass. |
| 78488 | Stackpole Carbon Co., St. Marys, Penn. |
| 78553 | Tinnerman Products, Inc., Cleveland, Ohio |
| 79089 | RCA, Commercial Receiving Tube and Semi-conductor Div., Harrison, N. J. |
| 79725 | Wiremold Co., Hartford, Conn. 06110 |
| 79963 | Zierick Mfg. Co., New Rochelle, N. Y. |
| 80030 | Prestole Fastener Div. Bishop and Babcock Corp., Toledo, Ohio |
| 80048 | Vickers Inc. Electric Prod. Div., St. Louis, Mo. |
| 80131 | Electronic Industries Assoc., Washington, D.C. |
| 80183 | Sprague Products Co., N. Adams, Mass. |
| 80211 | Motorola Inc., Franklin Park, Ill. 60131 |
| 80258 | Standard Oil Co., Lafeyette, Ind. |
| 80294 | Bourns Inc., Riverside, Calif. 92506 |
| 83033 | Meissner Mfg., Div. of Maguire Industries, Inc. Mount Carmel, Illinois |
| 80431 | Air Filter Corp., Milwaukee, Wisc. 53218 |
| 80583 | Hammarlund Co. Inc., New York, N. Y. |
| 80740 | Beckman Instruments, Inc., Fullerton, Calif. |
| 81073 | Grayhill Inc., LaGrange, Ill. 60525 |
| 81143 | Isolantite Mfg. Corp., Stirling, N. J. 07980 |
| 81349 | Military Specifications |
| 81350 | Joint Army-Navy Specifications |
| 81751 | Columbus Electronics Corp., Yonkers, N. Y. |
| 81831 | Filton Co., Flushing, L. I., N. Y |
| 81860 | Barry Controls Div. of Barry Wright Corp., Watertown, Mass. |
| 82219 | Sylvania Electric Products, Inc., (Electronic Tube Div.), Emporium, Penn. |
| 82273 | Indiana Pattern and Model Works, LaPort, Ind. |
| 82389 | Switchcraft Inc., Chicago, Ill. 60630 |
| 82647 | Metals and Controls Inc., Attleboro, Mass. |
| 82807 | Milwaukee Resistor Co., Milwaukee, Wisc. |
| 83058 | Carr Fastener Co., Cambridge, Mass. |
| 83186 | Victory Engineering Corp (IVECO), Springfield, N. J. 07081 |
| 83361 | Bearing Specialty Co., San Francisco, Calif. |
| 83587 | Solar Electric Corp., Warren, Penn. |
| 83740 | Union Carbide Corp., New York, N. Y. 10017 |
| 84411 | TRW Capacitor Div., Ogallala, Nebr. |
| 84835 | Lehigh Metal Products Corp., Cambridge, Mass. 02140 |
| 84971 | TA Mfg. Corp., Los Angeles, Calif. |
| 86577 | Precision Metal Products of Malden Inc., Stoneham, Mass. 02180 |
| 86684 | RCA (Electrical Component and Devices) Harrison. N. J. |
| 86800 | Continental Electronics Corp. Brooklyn, N.Y. 11222 |
| 88140 | Cutler-Hammer Inc., Lincoln, Ili. |
| 88219 | Gould Nat. Batteries Inc., Trenton, N. J. |
| 88419 | Cornell Dubilier Electric Corp., Fuquay-Varina, N. C. |
| 88627 | K and G Mfg. Co., New York, N. Y. |
| 89482 | Holtzer Cabot Corp., Boston, Mass. |
| 89665 | United Transformer Co., Chicago, Ill. |
| 90201 | Mallory Capacitor Co., Indianapolis, Ind. |
| 90750 | Westinghouse Electric Corp., Boston, Mass. |
| 90952 | Hardware Products Co., Reading, Penn. 19602 |
| 91032 | Continental Wire Corp., York, Penn. 17405 |
| 91146 | ITT Cannon Electric Inc., Salem, Mass. |
| 91293 | Johanson Mfg. Co., Boonton, N. J. 07005 |
| 91598 | Chandler Co., Wethersfield, Conn. 06109 |
| 91637 | Dale Electronics Inc., Columbus, Nebr. |
| 91662 | Elco Corp., Willow Grove, Penn. |
| 91719 | General Instruments, Inc., Dallas, Texas |
| 91929 | Honeywell Inc., Freeport, Ill. |
| 92519 | Electra Insulation Corp., Woodside, Long Island, N. Y. |
| 92678 | Edgerton, Germeshausen and Grier, Boston, Mass. |
| 93332 | Sylvania Electric Products, Inc., Woburn, Mass. |
| 93916 | Cramer Products Co., New York, N. Y. 10013 |
| 94144 | Raytheon Co. Components Div., Quincy, Mass. |
| 94154 | Tung Sol Electric Inc., Newark, N. J. |
| 95076 | Garde Mfg. Co., Cumberland, R. I. |
| 95146 | Alco Electronics Mfg. Co., Lawrence, Mass. |
| 95238 | Continental Connector Corp., Woodside, N. Y. |
| 95275 | Vitramon, Inc., Bridgeport, Conn. |
| 95354 | Methode Mfg. Co., Chicago, Ill. |
| 95412 | General Electric Co., Schenectady, N. Y. |
| 95794 | Ansconda American Brass Co., Torrington, Conn. |
| 96095 | Hi-Q Div. of Aerovox Corp., Orlean, N. Y. |
| 96214 | Texas Instruments Inc., Dallas, Texas 75209 |
| 96256 | Thordarson-Meissner Div. of McGuire, Mt. Carmel, Ill. |
| 96341 | Microwave Associates Inc., Burlington, Mass. |
| 96791 | Amphenoe Corp. Jonesville, Wisc. 53545 |
| 96906 | Military Standards |
| 97966 | CBS Electronics Div. of Columbia Broadcasting Systems, Danvers, Mass. |
| 98291 | Sealectro Corp., Mamaroneck. N. Y. 10544 |
| 98821 | North Hills Electronics Inc., Glen Cove, N. Y. |
| 99180 | Transitron Electronics Corp., Melrose, Mass. |
| 99378 | Atlee Corp., Winchester, Mass. 01890 |
| 99800 | Delevan Electronics Corp., E. Aurora, N. Y. |

5/68

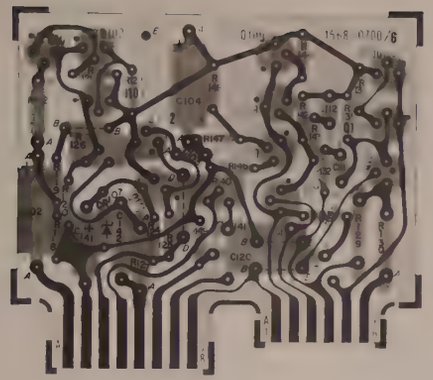


Figure 6-6. High Q circuit etched-board assembly (P/N 1568-2700).

Figure 6-7. Etched-board assembly (P/N 1568-2720).

NOTE: The number appearing on an etched board is the number of the board only, without circuit components. When ordering a new etched-board assembly, use the part number listed in the figure caption

A dot near a transistor on the etched-board assembly indicates the collector of that transistor.

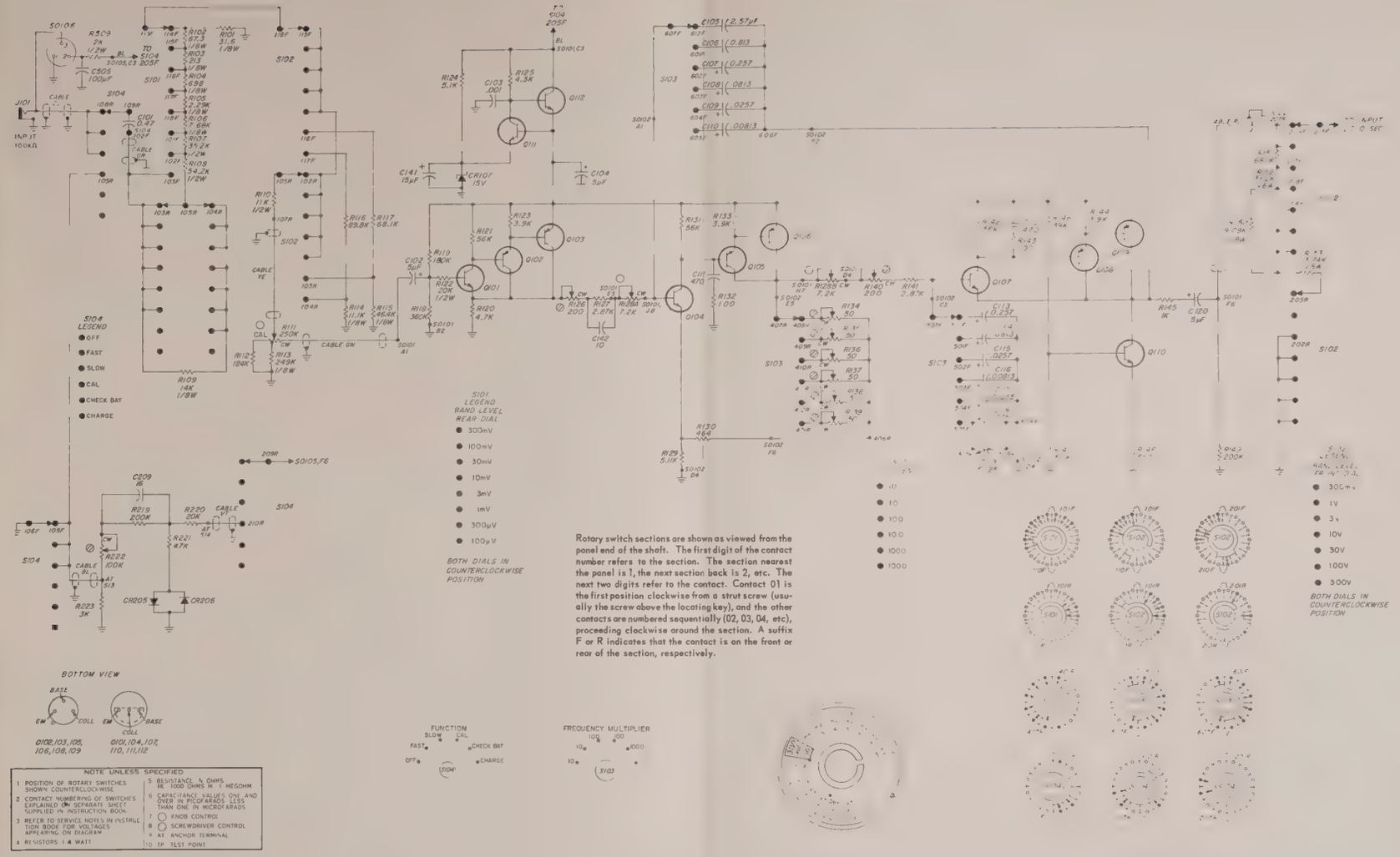

S104 LEGEND
OFF
FAST
SLOW
CAL
CHECK BAT
CHARGE
S101 LEGEND BAND LEVEL REAR DIAL
300mV
100mV
30mV
10mV
3mV
1mV
300μV
100μV
BOTH DIALS IN COUNTERCLOCKWISE POSITION
Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.
BOTTOM VIEW
Q102,103,105, 106,108,109
Q101,104,107, 110,111,112
NOTE UNLESS SPECIFIED
1 POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2 CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3 REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4 RESISTORS 1/4 WATT
5 RESISTANCE 1/2 OHMS IK 1000 OHMS M 1 MEGOHM
6 CAPACITANCE VALUES ONE AND OVER IN MICROFARADS LESS THAN ONE IN MICROFARADS
7 KNOB CONTROL
8 SCREWDRIVER CONTROL
9 AT ANCHOR TERMINAL
10 TP TEST POINT
FUNCTION
FREQUENCY MULTIPLIER
BOTH DIALS IN COUNTERCLOCKWISE POSITION

Figure 6-8. High Q and input circuits schematic diagram.

| Ref. No. | Description | Part No. | Fed. Mfg. Code | Mfg. Part No. | Fed. Stock Number |
|---|---|---|---|---|---|
| **CAPACITORS** | | | | | |
| C120 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 204059S9C10X3 | 5910-448-5527 |
| C121 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 204059S9C10X3 | 5910-448-5527 |
| C122 | Ceramic, 0.001 µF ±5% 500 V | 4405-2105 | 72982 | 801, 0.001 µF ±5% | |
| C123 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 204059S9C10X3 | 5910-448-5527 |
| C124 | Plastic, 0.257 µF ±0.25% 100 V | 4869-3257 | 24655 | 4869-3257 | |
| C125 | Plastic, 0.0813 µF ±0.25% 100 V | 4868-2813 | 24655 | 4868-2813 | |
| C126 | Plastic, 0.0257 µF ±0.25% 100 V | 4868-2257 | 24655 | 4868-2257 | |
| C127 | Plastic, 0.00813 µF ±0.25% 25 V | 4868-1813 | 24655 | 4868-1813 | |
| C128 | Plastic, 0.00255 µF ±0.25% 25 V | 4868-1255 | 24655 | 4868-1255 | |
| C129 | Plastic, 775 pF ±0.5% 25 V | 4868-0775 | 24655 | 4868-0775 | |
| C130 | Trimmer, 5 pF to 25 pF | 4910-1150 | 72982 | 557-051, U2P0 | |
| C131 | Ceramic, 470 pF ±10% 500 V | 4404-1478 | 72982 | 831, 470 pF ±10% | |
| C132 | Plastic (special) 2.57 µF ±0.25% 150 V | 4860-4901 | 84411 | 663UW, 2.57 µF ±0.25% | |
| C133 | Plastic (special) 0.813 µF ±0.25% 150 V | 4872-4812 | 24655 | 4872-4812 | |
| C134 | Plastic, 0.257 µF ±0.25% 100 V | 4869-3257 | 24655 | 4869-3257 | |
| C135 | Plastic, 0.0813 µF ±0.25% 100 V | 4868-2813 | 24655 | 4868-2813 | |
| C136 | Plastic, 0.0257 µF ±0.25% 100 V | 4868-2257 | 24655 | 4868-2257 | |
| C137 | Plastic, 0.00813 µF ±0.25% 25 V | 4868-1813 | 24655 | 4868-1813 | |
| C138 | Electrolytic, 22 µF ±20% 15 V | 4450-5300 | 56289 | 150D226X0015B2 | 5910-752-4270 |
| C139 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C141 | Electrolytic, 15 µF ±20% 20 V | 4450-5200 | 56289 | 150D156X0020B2 | 5910-855-6335 |
| C142 | Mica, 10 pF ±1% 500 V | 4620-0100 | 72136 | CM15, 10 pF ±1% | |
| C143 | Ceramic, 470 pF ±10% 500 V | 4404-1478 | 72982 | 831, 470 pF ±10% | |
| C201 | Electrolytic, 200 µF +100 -10% 6 V | 4450-2610 | 37942 | TT, 200 µF +100 -10% | 5910-945-1836 |
| C202 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C203 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C204 | Electrolytic, 120 µF ±20% 10 V | 4450-5616 | 56289 | 150D127X0010R2 | |
| C205 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C206 | Electrolytic, 40 µF +100 -10% 6 V | 4450-3600 | 37942 | 20-40707S4 | 5910-952-0467 |
| C207 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C208 | Electrolytic, 5 µF +100 -10% 50 V | 4450-3900 | 37942 | 2040595S9C10X3 | 5910-448-5527 |
| C209 | Mica, 16 pF ±5% 500 V | 4700-0210 | 14655 | 22ASQ16JC | |
| C211 | Plastic, 0.0082 µF ±5% 200 V | 4860-7520 | 84411 | 663UW, 0.0082 µF ±5% | |
| **DIODES** | | | | | |
| CR109 | Zener, 15 V, ±5% Type 1N965B | 6083-1047 | 07910 | 1N965B | 5961-877-6192 |
| CR111 | Zener, 10 V, Type 1N758A | 6083-1063 | 04713 | 1N758A | |
| CR201 thru CR204 | High-speed, Type 1N191 | 6082-1008 | 93916 | 1N191 | 5961-296-3360 |
| **TRANSISTORS** | | | | | |
| Q113 | Type 2N3416 | 8210-1047 | 24446 | 2N3416 | 5961-989-2749 |
| Q114 | Type 2N3416 | 8210-1047 | 24446 | 2N3416 | 5961-989-2749 |
| Q115 | Type 2N3390 | 8210-1077 | 24454 | 2N3390 | |
| Q116 | Type 2N1131 | 8210-1025 | 96214 | 2N1131 | 5961-081-8365 |
| Q117 | Type 2N1131 | 8210-1025 | 96214 | 2N1131 | 5961-081-8365 |
| Q118 | Type 2N3390 | 8210-1077 | 24454 | 2N3390 | |
| Q119 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q120 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q121 | Type 2N3416 | 8210-1047 | 24446 | 2N3416 | 5961-989-2749 |
| Q122 | Type 2N3390 | 8210-1077 | 24454 | 2N3390 | |
| Q123 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q124 | Type 2N3250 | 8210-1089 | 80211 | 2N3250 | 5961-945-4108 |
| Q201 thru Q204 | Type 2N3416 | 8210-1047 | 24446 | 2N3416 | 5961-989-2749 |
| **RESISTORS** | | | | | |
| R160 | Composition, 5.1 kΩ ±5% 1/4 W | 6099-2515 | 75042 | BTS, 5.1 kΩ ±5% | 5905-279-4623 |
| R161 | Composition, 4.3 kΩ ±5% 1/4 W | 6099-2435 | 75042 | BTS, 4.3 kΩ ±5% | |
| R162 | Precision, (special) 2.87 kΩ ±0.25% | 6690-6254 | 24655 | 6690-6254 | |
| R163 | Potentiometer, wire-wound 200 Ω ±5% | 6053-1205 | 75042 | CT-106-2, 200 Ω | |
| R164 | Composition, 56 kΩ ±5% 1/4 W | 6099-3565 | 75042 | BTS, 56 kΩ ±5% | 5905-800-0179 |
| R165 | Composition, 100 Ω ±5% 1/4 W | 6099-1105 | 75042 | BTS, 100 Ω ±5% | |
| R166 | Composition, 39 kΩ ±5% 1/4 W | 6099-3395 | 75042 | BTS, 39 kΩ ±5% | 5905-686-3358 |
| R167 | Composition, 3.9 kΩ ±5% 1/4 W | 6099-2395 | 75042 | BTS, 3.9 kΩ ±5% | |
| R168 | Composition, 5.1 kΩ ±5% 1/4 W | 6099-2515 | 75042 | BTS, 5.1 kΩ ±5% | 5905-279-4623 |



| Ref. No. | Description | Part No. | Fed Mfg. Code | Mfg. Part No. | Fed. Stock Number |
|---|---|---|---|---|---|
| **RESISTORS (cont)** | | | | | |
| R169 | Composition, 510 Ω ±5% 1/4 W | 6099-1515 | 75042 | BTS, 510 Ω ±5% | 5905-801-8272 |
| R170 | Composition, 5.1 kΩ ±5% 1/4 W | 6099-2515 | 75042 | BTS, 5.1 kΩ ±5% | 5905-279-4623 |
| R171 | Precision, (special) 2.87 kΩ ±0.25% | 6690-6254 | 24655 | 6690-6254 | |
| R172 | Potentiometer, wire-wound 200 Ω ±5% | 6053-1205 | 75042 | CT-106-2, 200 Ω | |
| R173 | Precision, (special) 5.11 kΩ ±0.25% | 6690-6286 | 24655 | 6690-6286 | |
| R174 | Precision, (special) 464 Ω ±0.25% | 6690-6226 | 24655 | 6690-6226 | |
| R175 | Composition, 56 kΩ ±5% 1/4 W | 6099-3565 | 75042 | BTS, 56 kΩ ±5% | 5905-800-0179 |
| R176 | Composition, 100 Ω ±5% 1/4 W | 6099-1105 | 75042 | BTS, 100 Ω ±5% | |
| R177 | Composition, 3.9 kΩ ±5% 1/4 W | 6099-2395 | 75042 | BTS, 3.9 kΩ ±5% | |
| R178 thru R183 | Potentiometer, wire-wound 50 Ω ±5% | 6058-0505 | 75042 | CT-100, 50Ω ±5% | |
| R184 | Composition, 3 kΩ ±5% 1/4 W | 6099-2305 | 75042 | BTS, 3 kΩ ±5% | 5905-682-4097 |
| R185 | Composition, 200 kΩ ±5% 1/4 W | 6099-4205 | 75042 | BTS, 200 kΩ ±5% | 5905-681-8821 |
| R186 | Film, 14.7 kΩ ±1% 1/8 W | 6250-2147 | 75042 | CEA, 14.7 kΩ ±1% | 5905-702-1143 |
| R187 | Film, 21.5 kΩ ±1% 1/8 W | 6250-2215 | 75042 | CEA, 21.5 kΩ ±1% | 5905-615-7339 |
| R201 | Composition, 2 kΩ ±5% 1/4 W | 6099-2205 | 75042 | BTS, 2 kΩ ±5% | 5905-279-4629 |
| R202 | Composition, 10 kΩ ±5% 1/4 W | 6099-3105 | 75042 | BTS, 10 kΩ ±5% | 5905-686-2238 |
| R203 | Composition, 2 kΩ ±5% 1/4 W | 6099-2205 | 75042 | BTS, 2 kΩ ±5% | 5905-279-4629 |
| R204 | Composition, 20 kΩ ±5% 1/4 W | 6099-3205 | 75042 | BTS, 20 kΩ ±5% | 5905-686-3368 |
| R205 | Composition, 4.3 kΩ ±5% 1/4 W | 6099-2435 | 75042 | BTS, 4.3 kΩ ±5% | |
| R206 | Composition, 3.6 kΩ ±5% 1/4 W | 6099-2365 | 75042 | BTS, 3.6 kΩ ±5% | 5905-577-0627 |
| R207 | Film, 30.1 kΩ ±1% 1/8 W | 6250-2301 | 75042 | CEA, 30.1 kΩ ±1% | 5905-702-1760 |
| R208 | Composition, 47 kΩ ±5% 1/4 W | 6099-3475 | 75042 | BTS, 47 kΩ ±5% | 5905-683-2246 |
| R209 | Composition, 4.7 kΩ ±5% 1/4 W | 6099-2475 | 75042 | BTS, 4.7 kΩ ±5% | 5905-686-4998 |
| R210 | Composition, 24 kΩ ±5% 1/4 W | 6099-3245 | 75042 | BTS, 24 kΩ ±5% | |
| R211 | Composition, 1 kΩ ±5% 1/4 W | 6099-2105 | 75042 | BTS, 1 kΩ ±5% | 5905-681-8402 |
| R212 | Composition, 1 kΩ ±5% 1/4 W | 6099-2105 | 75042 | BTS, 1 kΩ ±5% | 5905-681-8402 |
| R213 | Composition, 100 kΩ ±5% 1/4 W | 6099-4105 | 75042 | BTS, 100 kΩ ±5% | 5905-686-3129 |
| R214 | Composition, 27 kΩ ±5% 1/4 W | 6099-3275 | 75042 | BTS, 27 kΩ ±5% | 5905-683-3388 |
| R215 | Composition, 6.2 kΩ ±5% 1/4 W | 6099-2625 | 75042 | BTS, 6.2 kΩ ±5% | 5905-682-4100 |
| R216 | Composition, 16 kΩ ±5% 1/4 W | 6099-3165 | 75042 | BTS, 16 kΩ ±5% | |
| R217 | Composition, 1.8 kΩ ±5% 1/4 W | 6099-2185 | 75042 | BTS, 1.8 kΩ ±5% | 5905-688-3738 |
| R218 | Composition, 200 kΩ ±5% 1/4 W | 6099-4205 | 75042 | BTS, 200 kΩ ±5% | 5905-681-8821 |
| R219 | Composition, 200 kΩ ±5% 1/4 W | 6099-4205 | 75042 | BTS, 200 kΩ ±5% | 5905-681-8821 |
| R220 | Composition, 20 kΩ ±5% 1/4 W | 6099-3205 | 75042 | BTS, 20 kΩ ±5% | 5905-686-3368 |
| R221 | Composition, 47 kΩ ±5% 1/4 W | 6099-3475 | 75042 | BTS, 47 kΩ ±5% | 5905-683-2246 |
| R222 | Potentiometer, composition 100 kΩ ±20% | 6040-1000 | 01121 | FWC, 100 kΩ ±20% | 5905-958-7949 |
| R223 | Composition, 3 kΩ ±5% 1/4 W | 6099-2305 | 75042 | BTS, 3 kΩ ±5% | 5905-682-4097 |
| R224 | Composition, 3 kΩ ±5% 1/4 W | 6099-2305 | 75042 | BTS, 3 kΩ ±5% | 5905-682-4097 |
| R226 | Composition, 3.3 kΩ ±5% 1/4 W | 6099-2335 | 75042 | BTS, 3.3 kΩ ±5% | 5905-681-9969 |
| **SOCKETS** | | | | | |
| SO103 | 6-Connector, | 4230-2706 | 95354 | CD606SF | |
| SO104 | 8-Connector, | 4230-2708 | 95354 | CD608SF | |
| SO105 | 8-Connector, | 4230-2708 | 95354 | CD608SF | |
| **MISCELLANEOUS** | | | | | |
| J201 | JACK, Telephone OUTPUT | 4260-1500 | 82389 | 2J-1503 | 5935-636-5923 |
| M201 | METER, Panel, 100 µA | 5730-1389 | 40931 | Meds 1389 | |

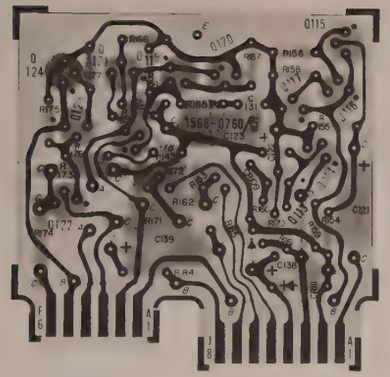



Figure 6-9. Low Q circuit etched-board assembly (P/N 1568-2760)

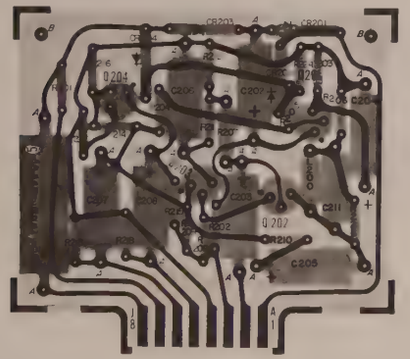


Figure 6-10. Output circuit etched-board assembly (P/N 1568-2770)

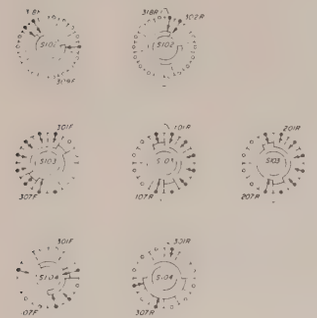
Figure 6-11. Etched-board assembly (P/N 1568-2730).

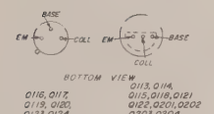
NOTE

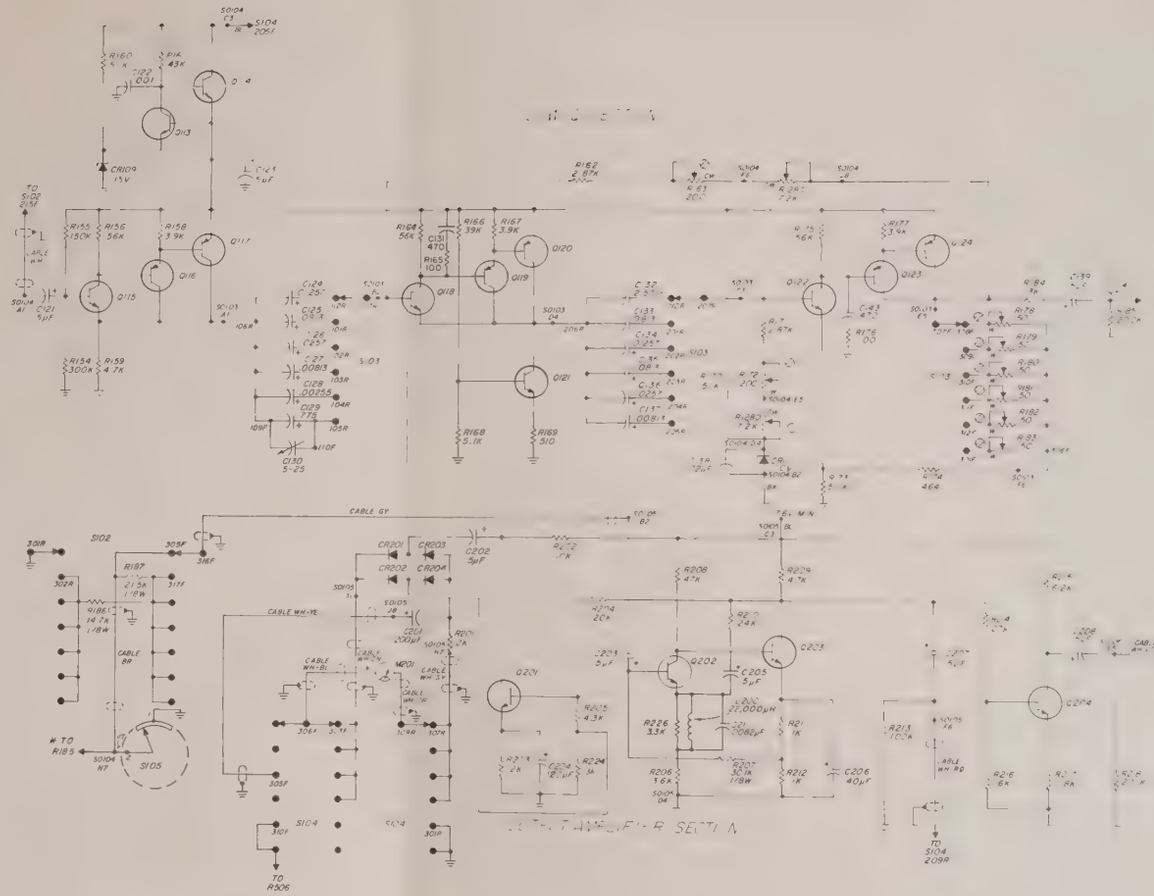
The number shown on the foil side of the board is not the part number for the complete assembly. The assembly number is given in the caption.

The dot on the foil at the transistor socket indicates the collector lead.

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.





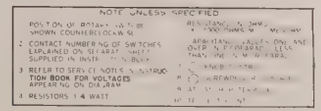
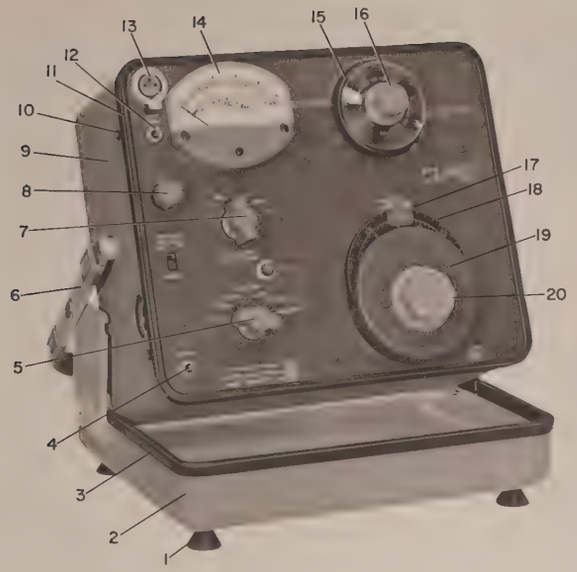


Figure 6-12. Low Q and output circuits schematic diagram.




## MECHANICAL PARTS LIST

| Ref. No. | Name | Description | GR Part No. | Fed. Mfg. Code | Mfg. Part No. | Fed. Stock No. |
|---|---|---|---|---|---|---|
| 1 | FOOT | Rubber | 5250-1902 | 24655 | 5250-1902 | |
| 2 | COVER ASM. | Includes feet and gasket | 4170-2071 | 24655 | 4170-2071 | |
| 3 | GASKET | Rubber gasket for cabinet edge | 5167-5429 | 24655 | 5167-5429 | |
| 4,12 | DRESS NUT | Nut, 3/8-32 | 5800-0799 | 24655 | 5800-0799 | 5310-991-7168 |
| 5 | KNOB | Knob Assembly | 5500-1800 | 24655 | 5500-1800 | |
| 6 | HANDLE AND BRACKET ASM. | Complete assembly | 1568-2100 | 24655 | 1568-2100 | |
| 7 | KNOB | Knob assembly | 5500-1700 | 24655 | 5500-1700 | |
| 8 | KNOB | Knob assembly | 5540-3000 | 24655 | 5540-3000 | 5355-844-3123 |
| 9 | CABINET ASM. | Doesn't include Ref. 2 or 5 | 1568-1010 | 24655 | 1568-1010 | |
| 10 | SCREW | Panel screw and washer, No. 10-32, 1/2 in. | 7098-0160 | 24655 | 7098-0160 | |
| 11 | GASKET | Rubber, 35-inches long | 5168-1350 | 24655 | 5168-1350 | |
| 13 | SOCKET | 3-connector Cannon XLR female socket | 4230-2696 | 71468 | XLR-3-1 | |
| 14 | METER COVER | Plastic, dark gray, 4 inches | 5720-4714 | 24655 | 5720-4714 | |
| 15 | DIAL | Inner dial, black | 1568-1020 | 24655 | 1568-1020 | |
| 16 | KNOB AND DIAL | Complete assembly | 1568-2080 | 24655 | 1568-2080 | |
| 17 | SCREW (2 required) | Binder head, No. 4-40, 1/2 inch | 7060-1800 | 24655 | 7060-1800 | |
| | SPACER (2 required) | Metal, No. 4, 11/32 inch | 7640-0900 | 24655 | 7640-0900 | |
| | INDICATOR | Plastic | 5470-0651 | 24655 | 5470-0651 | |
| 18 | DIAL | Marked dial | 1568-8200 | 24655 | 1568-8200 | |
| 19 | FREQUENCY DIAL COVER ASM. | Painted cover assembly | 0907-1061 | 24655 | 0907-1061 | |
| 20 | KNOB AND PINION ASM | Complete assembly | 0907-0351 | 24655 | 0907-0351 | |



## PARTS LIST

| Ref. No. | Description | Part No. | Fed. Mfg. Code | Mfg. Part No. | Fed. Stock Numb. |
|---|---|---|---|---|---|
| **CAPACITORS** | | | | | |
| C501A | 300 µF | | | | |
| C501B | Electrolytic, 150 µF +100 -10% 150 V | 4450-5602 | 37942 | 20-22287991 | 5910-931-7039 |
| C501C | 150 µF | | | | |
| C502 | Electrolytic, 25 µF +100 -10% 100 V | 4450-5596 | 80183 | DEE, 25 µF +100 -10% | |
| C503 | Electrolytic, 50 µF +100 -10% 50 V | 4450-2200 | 80183 | TT, 50 µF +100 -10% | 5910-799-9283 |
| C504 | Electrolytic, 50 µF +100 -10% 50 V | 4450-2200 | 80183 | TT, 50 µF +100 -10% | 5910-799-928? |
| C505 | Electrolytic, 100 µF +100 -10% 25 V | 4450-2300 | 76149 | 20-40595 | 5910-799-9284 |
| **DIODES** | | | | | |
| CR501 thru CR504 | Rectifier, Type 1N3254 | 6081-1002 | 09213 | 1N3254 | 5961-082-3988 |
| CR505 thru CR508 | Rectifier, Type 1N3253 | 6081-1001 | 79089 | 1N3253 | 5961-814-4251 |
| **RESISTORS** | | | | | |
| R501 | Power, 5.1 kΩ ±5% 3 W | 6680-2515 | 80183 | 242E, 5.1 kΩ ±5% | |
| R502 | Composition, 100 kΩ ±5% 1 W | 6110-4105 | 01121 | RC32GF104J | 5905-299-2003 |
| R503 thru R505 | Composition, 360 Ω ±5% 1/4 W | 6099-1365 | 75042 | BTS, 360 Ω ±5% | |
| R506 | Film, 287 kΩ ±1% 1/8 W | 6250-3287 | 75042 | CEA, 287 kΩ ±1% | 5905-615-7336 |
| R507 | Composition, 47 Ω ±5% 1/2 W | 6100-0475 | 01121 | RC20GF470J | 5905-252-4018 |
| R508 | Power, 10 kΩ ±5% 5 W | 6660-3105 | 80183 | 246E, 10 kΩ ±5% | 5905-840-2578 |
| R509 | Composition, 2 kΩ ±5% 1/2 W | 6100-2205 | 01121 | RC20GF202J | 5905-190-8887 |
| **SWITCHES** | | | | | |
| S502 | Slide, MULTIPLIER SWITCHING | 7910-0772 | 76854 | #75 | |
| S503 | Microswitch, SPDT | 3030-4240 | 24655 | 3030-4240 | |
| S504 | Rotary, 2-position (connected to S104) power | 7890-4040 | 24655 | 7890-4040 | |
| **MISCELLANEOUS** | | | | | |
| B501 | BATTERY, 9.6 V, Nickel-cadmium rechargeable, 450 mAh | 8410-0410 | 24655 | 8410-0410 | |
| MO501 | MOTOR, 12-position stepping | 5760-3070 | 81840 | 215251-031 | |
| P501 | LAMP, Pilot, assembly (28-V) | 7510-1391 | 72765 | 121-28-204 (red) | |
| PL501 | PLUG, Power, 3-connector | 4240-0702 | 24655 | 4240-0702 | |
| T501 | TRANSFORMER, Power | 0746-4420 | 24655 | 0746-4420 | 5935-993-9847 |

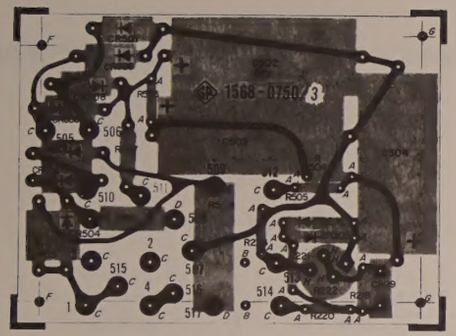



Figure 6-13. Power supply etched-board assembly (P/N 1568-2750).

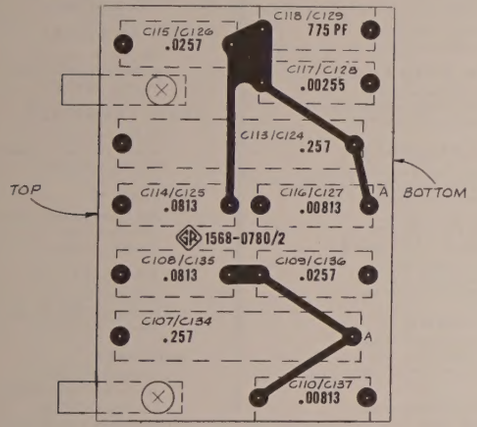
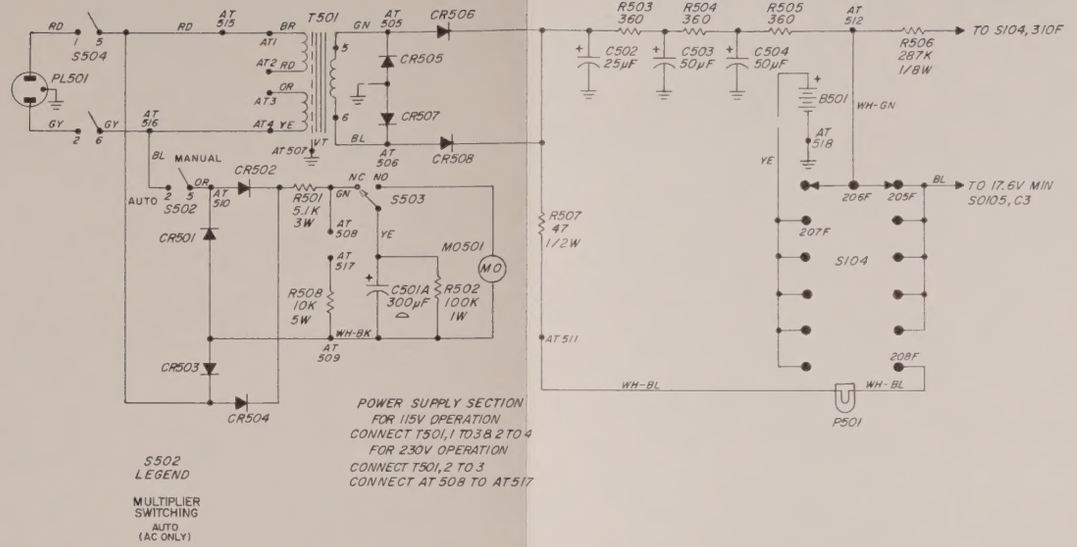



Figure 6-15. Capacitor stack etched-board assembly (P/N 1568-2780).

NOTE

The number shown on the foil side of the board is not the part number for the complete assembly. The assembly number is given in the caption.

The dot on the foil at the transistor socket indicates the collector lead.

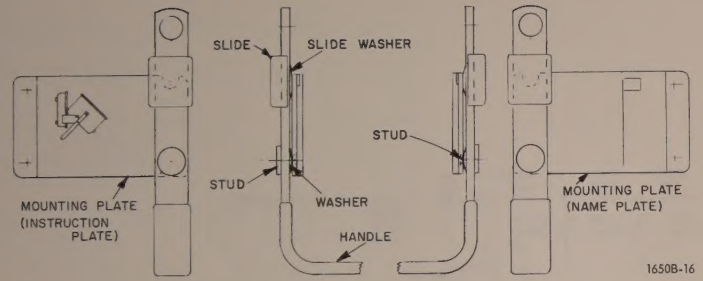


NOTE UNLESS SPECIFIED

1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE.
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.
4. RESISTORS 1/4 WATT.
5. RESISTANCE IN OHMS K 1000 OHMS M 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS, LESS THAN ONE IN MICROFARADS.
7. ◯ KNOB CONTROL
8. ◯ SCREWDRIVER CONTROL
9. AT ANCHOR TERMINAL
10. TP TEST POINT

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

Figure 6-14. Power supply schematic diagram.

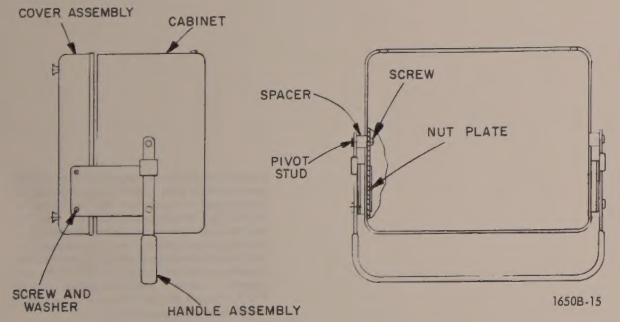



**Complete cabinet assembly (P/N 1568-2110).**

| Name | GR Part No. | Name | GR Part No. |
|---|---|---|---|
| Cabinet | 4182-8080 | Cover Assembly | 4170-2071 |
| Spacer | 4170-0700 | Nut Plate | 4170-1350 |
| Pivot Stud | 4170-1000 | Screw | 7080-1000 |
| Screw* | 7040-0400 | Washer | 8040-2400 |
| Handle Assembly | 5361-2000 | | |

| Name | GR Part No. | Name | GR Part No. |
|---|---|---|---|
| Mounting Plate** (Instruction Plate) | 7860-5800 | Mounting Plate** (Name Plate) | 7864-8220 |
| Stud | 4170-1100 | Washer | 8140-0105 |
| Slide | 4170-1270 | Slide Washer | 4170-7030 |
| Handle | 5360-1013 | | |

*Tighten 1/4 - 28 screws to 45-55 in. lbs torque.
**Bend mounting plate to give 1/32 to 1/16 spacing, both sides.




**Complete handle and mounting plate assembly (P/N 1568-2100).**



APPENDIX

## Type 1560-P40 PREAMPLIFIER

**FEATURES:** High input impedance; low output impedance. Low electrical noise level. Voltage gain of 1 or 10. Compact. Adaptable to many uses. Microphone cartridge attaches directly.

**USES:** The TYPE 1560-P40 Preamplifier is a high-input impedance, low-noise preamplifier. It is particularly well suited for amplifying the output of piezoelectric transducers, such as microphones and vibration pickups, and for driving long connecting cables without loss in signal voltage. It is also a useful probe amplifier for other electrical signals where its high input impedance and low noise are necessary. For example, it can increase the sensitivity and input impedance of the TYPES 1900, 1564, and 1558 Analyzers, the TYPE 1521 Graphic Level Recorder, the TYPE 1142 Frequency Meter, the TYPES 1150 and 1151 Digital Frequency Meters, the TYPES 1232, 1206, and 1233 Amplifiers, the TYPE 1806 Electronic Voltmeter, and low-frequency oscilloscopes.

**DESCRIPTION:** The TYPE 1560-P40 is a three-stage negative-feedback amplifier that makes full use of the low-noise and high-input-impedance characteristics of a unipolar transistor (FET). The feedback can be switched by the user to obtain a voltage gain of either 1:1 or 10:1. The amplifier is housed in a small cylindrical case. The GR TYPE 1560-P5 Microphone cartridge plugs directly on to the input end of the case. Adaptors are available for connecting the preamplifier to the cartridge of the GR TYPE 1560-P3 Microphone, to GR874 Connectors, and to 3-terminal microphone connectors. Output from the preamplifier is through a 3-terminal shielded connector. The required dc supply voltage is applied from one of these terminals to ground. This voltage can be obtained directly from the TYPES 1558 and 1564 Analyzers or the rechargeable-battery power supply listed under TYPE 1560-P40H, below.

The preamplifier and accessories are available in various combinations.

The TYPE 1560-P40H Preamplifier and Power Supply Set is self-powered and independent of any external supply so that it can be used with the TYPE 1900-A Wave Analyzer as well as with all the other instruments mentioned above (see USES).

The TYPE 1560-P40J Preamplifier and Adaptor Set is dependent for its power on the instrument to which it is connected, so that it should be used with the TYPES 1558 and 1564 Analyzers. If the connector from the source is not one of those for which an adaptor is supplied, the GR874 Adaptors listed on page 81 can be used with the TYPE 1560-P98 Adaptor to mate with almost all standard coaxial connectors.

The TYPE 1560-P40K Preamplifier and Microphone Set is for use with the TYPES 1558 and 1564 Analyzers when an acoustical measurement is needed at low levels and the microphone must be mounted at the end of a cable.

### SPECIFICATIONS

**Gain:** 1:1 or 10:1 (20 dB) ± 0.3 dB.
**Input Capacitance:** 6 pF.
**Input Resistance:** >500 MΩ at low audio frequencies.
**Output Resistance:** 1:1 gain — approx 5 Ω.
10:1 gain — approx 100 Ω.
**Noise:** ≤2.5 μV equivalent input voltage (400-pF source impedance, C-weighted, 8-kc effective bandwidth).
**Frequency Response:** ±0.3 dB from 5 c/s to 500 kc/s.
**Harmonic Distortion at Audio Frequencies:**
Open circuit, at 1 V, peak-to-peak: <0.25%.
Capacitor load of 0.01 μF (equivalent to a cable over 200-ft long): Maximum output (peak-to-peak) at 1% distortion is 5 V for 1 kc/s, 2 V for 10 kc/s.
**Accessories Available** (in combinations listed below): Power supply, includes two 9.6-volt nickel-cadmium rechargeable batteries, a charging circuit, a battery-check light, and a power cord.

**TYPE 1560-P40H PREAMPLIFIER AND POWER SUPPLY SET**
*Consists of:*
Type 1560-P40 Preamplifier
Type 1560-P96 Adaptor
Type 1560-P98 Adaptor
Type 1560-P95 Adaptor Cable
Type 1560-P99 Adaptor Cable
Type 1560-P72C Cable (4 ft)
Type 874-Q2 Adaptor
Power Supply
**Shipping Weight:** 10 lb (4.6 kg).

**TYPE 1560-P40J PREAMPLIFIER AND ADAPTOR SET**
*Consists of:*
Type 1560-P40 Preamplifier
Type 1560-P96 Adaptor
Type 1560-P97 Adaptor
Type 1560-P98 Adaptor
Type 1560-P72C Cable (4 ft)
**Shipping Weight:** 4 lb (1.9 kg).

**TYPE 1560-P40K PREAMPLIFIER AND MICROPHONE SET**
*Consists of:*
Type 1560-P40 Preamplifier
Type 1560-P72C Cable (4 ft)
Type 1560-P72 Cable (25 ft)
Type 1560-P32 Tripod
Microphone Cartridge
**Shipping Weight:** 14 lb (6.5 kg).

TYPES 1560-P96, 1560-P97, and 1560-P98 Adaptors for converting the input pin connections to 3-terminal shielded microphone connectors, to the pin sockets necessary for the cartridge of a TYPE 1560-P3 Microphone, and to a General Radio TYPE 874 Connector, respectively.

TYPES 1560-P72 (25-ft) and 1560-P72C (4-ft) cables for supplying power to and transferring the signal from the preamplifier.

TYPE 1560-P95 Adaptor Cable for connecting the signal from the power supply through a cable to a TYPE 274 Double Plug.

TYPE 1560-P99 Adaptor Cable for connection from phone plug to microphone plug.

**Power Supply:** 15 V to 25 V, 1 mA to 2 mA, dc.
**Dimensions:** length 6⅝, diameter 1.155 by 1 in (175, 30, 26 mm).
**Net Weight:** 9 oz (0.3 kg).
**Shipping Weight:** 3 lb (1.4 kg).


# GENERAL RADIO COMPANY

WEST CONCORD, MASSACHUSETTS 01781

617 369-4400 617 646-7400


## DISTRICT OFFICES

**METROPOLITAN NEW YORK***
*845 Broad Avenue*
*Ridgefield, New Jersey 07657*
*Telephone N.Y. 212 964-2722*
*N.J. 201 943-3140*

**SYRACUSE**
*Pickard Building*
*East Molloy Road*
*Syracuse, New York 13211*
*Telephone 315 454-9323*

**NEW ENGLAND***
*22 Baker Avenue*
*West Concord, Massachusetts 01781*
*Telephone 617 646-0550*

**PHILADELPHIA**
*Fort Washington Industrial Park*
*Fort Washington, Pennsylvania 19034*
*Telephone 215 646-8030*

**WASHINGTON* AND BALTIMORE**
*11420 Rockville Pike*
*Rockville, Maryland 20852*
*Telephone 301 946-1600*

**ORLANDO**
*113 East Colonial Drive*
*Orlando, Florida 32801*
*Telephone 305 425-4671*

**CHICAGO***
*9440 W. Foster Avenue*
*Chicago, Illinois 60656*
*312 992-0800*

**CLEVELAND**
*5579 Pearl Road*
*Cleveland, Ohio 44129*
*Telephone 216 886-0150*

**LOS ANGELES***
*1000 North Seward Street*
*Los Angeles, California 90038*
*Telephone 213 469-6201*

**SAN FRANCISCO**
*626 San Antonio Road*
*Mountain View, California 94040*
*Telephone 415 948-8233*

**DALLAS***
*2600 Stemmons Freeway, Suite 210*
*Dallas, Texas 75207*
*Telephone 214 637-2240*

**TORONTO***
*99 Floral Parkway*
*Toronto 15, Ontario, Canada*
*Telephone 416 247-2171*

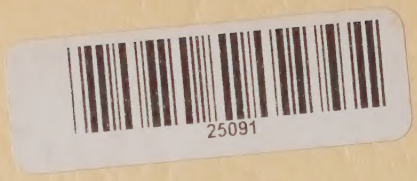
**MONTREAL**
*1255 Laird Boulevard*
*Town of Mount Royal, Quebec, Canada*
*Telephone 514 737-3673*

OTTAWA *Telephone 613 233-4237*

* Repair services are available at these district offices.

*General Radio Company (Overseas), 8008 Zurich, Switzerland*
*General Radio Company (U.K.) Limited, Bourne End, Buckinghamshire, England*
*Representatives in Principal Overseas Countries*

Printed in USA




GENERAL RADIO
WEST CONCORD, MASSACHUSETTS 01781

MP MASTER